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Eleventh Contribution to the Herpetology of Tropical America.

By E. D. Cope.

(*Read before the American Philosophical Society, June 20th*, 1879.)

The materials studied in the preparation of the present paper, are the following:

1. A collection made at Batopilas in Southern Chihuahua, by Edward Wilkinson, Jr.

2. Two collections made at Guanajuato on the Mexican Plateau, by Dr. Alfredo Dugés.

3. A collection from the Isthmus of Tehuantepec, by Francis Sumichrast.

4. A collection made in Costa Rica from Jose Zelodon.

5. Three collections from the Island of Santo Domingo, made by Messrs. Wm. M. Gabb and Charles A. Fraser and Dr. J. J. Brown.

6. A collection from the Island of Dominica, made by Ferdinand Ober.

7. A collection from the Island of Tobago, also from Ferd. Ober.

8. A few specimens from North west Bolivia, from the late Prof. James Orton.

Of these, all excepting Nos. 1 and 8, and a part of No. 2, belong to the Smithsonian Institution, and have been placed in my hands for identification, by Professor Baird, the Secretary.

No. I. Batopilas, Wilkinson.

Batopilas is a mining town of Chihuahua, in a region celebrated for the extent and richness of its silver deposits. It is on the western side of the water shed of the Cordilleras on the upper waters of a tributary of the Rio Fuerte, which forms in the lower part of its course the boundary dividing the States of Sonora and Cinaloa. The surrounding country is mountainous and dry.

This locality is one of especial interest in its relations to the faunal districts of the adjacent parts of Mexico and the United States. The absence of *Batrachia* and Turtles from Mr. Wilkinson's collection shows its similarity to the elevated regions north and south of it.

Lacertilia.

1. *Anolis nebulosus* Wiegm.
2. *Cyclura acanthura* Wiegm.
3. *Uta bicarinata* Dum.
4. *Sceloporus tristichus* Cope. Report U. S. G. G. Survey W. of 100th Mer. G. M. Wheeler, Vol. III, p. 571.
5. *Sceloporus clarkii* Bd. Gird.
6. *Phrynosoma cornutum* Harl.
7. *Phyllodactylus tuberculosus* Wiegm.
8. *Cnemidophorus communis* Cope, Var. II. Proceedings American Philosophical Society, 1877, p. 95.

PROC. AMER. PHILOS. SOC. XVIII. 104. 2H. PRINTED AUGUST 11, 1879.

OPHIDIA.

9. *Stenostoma humile* B. & G.

10. *Procinura æmula* Cope, gen. et. sp. nov.

Char. gen. Dentition opisthoglyph. Form that of *Elapomorphus*. Two nasal, one loreal, and one preocular plates; internasals and prefrontals distinct. Scales smooth, excepting those of the posterior dorsal and caudal regions, where they are keeled, those of the latter so much so as to be tubercular. Anal plate double.

This genus is near to *Scolecophis* Cope, but the peculiar tubercular carination of the tail distinguishes it. The only known species inhabits a rocky, mountainous region, and I have little doubt that this peculiar character enables the animal to force itself into the earth or beneath stones. The tail is used as a fulcrum in pushing against rough and resistant bodies.

Char. specif. Scales broad rounded, in fifteen longitudinal series, the median rows rather smaller than the lateral, of which three rows are equal. Muzzle projecting beyond the mandible, rounded, the rostral plate visible from above, presenting an obtuse angle posteriorly. Top of head flat. Prefrontals much wider than long, their external canthal border equal to that of the internasals. Frontal wide, sending a long angle backwards. Parietals short, wide; temporals 1-2, the first small, as deep as long. Superior labials seven, all except the first, deeper than long, the third and fourth entering the orbit. Preorbital vertical, narrow, not reaching frontal; postorbitals two, equal and small. Loreal quadrangular. Inferior labials eight, fourth largest; pregenecials three times as long as postgenecials and separated from gastrosteges by six rows of scales. The dorsal carinæ first appear on the twenty-second transverse row of scales anterior to the vent and occupy the median nine series. All the caudal series are keeled, and as they are wider than long, the free apices of the keels projecting, give them a depressed pyramidal form, Gastrosteges 148; urosteges 41.

In the coloration of the body this species is an almost exact repetition of the *Elaps fulvius*. It is surrounded by wide black rings, which are broadly bordered with yellow, and separated by red interspaces of twice their width. The scales of the red spaces have each a central black spot which are more distinct than in *E. fulvius*, on the anterior part of the body above the sides; posteriorly they are weaker. The black annuli pass round the belly, but all are somewhat broken anteriorly. Between them the gastrosteges have black shades. The coloration of the head differs from that of the *E. fulvius* in having merely a large black spot covering the parietal, superciliary and frontal plates, and extending round the eye but not reaching the edge of the lip. Muzzle and chin unspotted.

Total length, M. .364; length of rictus oris, .011; length of tail, .061.

Although this curious and handsome serpent so much resembles the *Elaps fulvius*, it is not yet known that the two species inhabit the same region.

11. *Phimothyra grahamiæ* B. & G., numerous specimens.

12. *Eutænia sirtalis* Linn. variety near the sub-species *ordinata*, having

the dorsal and lateral bands and lateral dark spots, obsolete. General color bright olive.

13. *Eutænia cyrtopsis* Kenn.
14. *Trimorphodon upsilon* Cope.
15. *Elaps euryxanthus* Kenn.

REMARKS.

This collection, though small, is of interest as serving to fix the extension of the Sonoran fauna to a point further south than has been hitherto practicable. The following are the faunal affinities of the fourteen species enumerated above. *Eutænia sirtalis* may be dismissed as common to Mexico and the Nearctic Realm; *Procinura æmula* may also be passed by as peculiar to the locality investigated, so far as yet known. *Stenostoma humile*, is, according to Baird and Girard, an inhabitant of the Pacific district, and is a very rare species. Species found in various parts of Mexico are: *Anolis nebulosus*, *Cyclura acanthura* and *Cnemidophorus communis*; the last occurring also in S. W. Texas. *Trimorphodon upsilon* is a species of West Mexico, having been found at Guadalaxara, Guanajuato, and the present locality; but is not as yet known from the West Coast. Six species are exclusively of the Sonoran district viz: *Sceloporus tristychus*; *S. clarki*, *Phimothyra grahamiæ*; *Eutænia cyrtopsis* and *Elaps euryxanthus*. *Phyllodactylus tuberculosus* belongs to the Sonoran fauna, but occurs also south of Batopilas in Western Mexico. *Phrynosoma cornutum* is also Sonoran, but is Texan besides. The comparison of this list so far as it relates to the Mexican fauna, is with that of the Tableland; only two species of it, occurring in the Tierra Caliente also; these are the generally distributed *Cyclura acanthura* and *Cnemidophorus communis*.

Mr. Wilkinson's collection contained a specimen of *Pelamis bicolor*, which he informs me was taken in the Gulf of California near Guaymas.

In the Proceedings of the Philadelphia Academy for 1868, p. 310, I noted that William Bischoff had sent to the Smithsonian Institution from Mazatlan the species *Agalychnis dacnicolor* Cope, *Leptodira personata* Cope, *Leptodira pacifica* Cope, and a species of *Holbrookia*, which I named *H. bischoffii*, but did not describe. Since then it has been described under the name of *H. elegans* by Bocourt (Mission Scientifique de Mexique 1874, p. 164), which name it must retain. I add to this list *Bufo debilis* Girard, which gives the extreme western limit of its range. It occurs also in West Texas.

II. GUANAJUATO, Duges.

One collection from this locality was sent me by Dr. Duges, and another collection was subsequently received by the Smithsonian Institution. I give the catalogue numbers of the specimens contained in the latter.

BATRACHIA.

1. *Spelerpes belli* Gray.
2. *Bufo punctatus* B. and G.
3. *Bufo intermedius* Günth.
4. *Bufo monksiæ* Cope, sp. nov.

Cranium without any crests, superior borders of orbits not reverted, can-

thus rostralis sharp, lores perpendicular, muzzle vertically descending to lip. Tympanic disc concealed, parotoid gland a wide oval, and rather large. Fingers moderate, first and second equal, fourth longer. Heel of extended posterior limb reaching posterior border of orbit. Web of toes measuring half the length of the shorter. Skin rough with small harsh tubercles, which are more remote on the back, but are closely appressed on all the inferior surfaces. They are especially acute on the limbs. There are two distinct tarsal tubercles, which are prominent, though small and without cutting edge.

Color above, blackish-brown with a few small ashen spots, and an ashen cross band extending across the eyelids and intervening frontal space. Lores and lips brown spotted; blackish spots on the sides, belly, throat and limbs.

Length of head and body, M. .035; axial length of head to angle of mandible, .010; width of head at angle of mandible, .012; length of hind limb, .042; length of hind foot, .020. No. 9896.

This is one of the few Mexican species without cranial crests, resembling in this respect, the *B. compactilis*;* *B. hæmatiticus*, and *B. politus*. From the first it differs in the absence of the fossorial spur; from the last two in the roughness of the skin, and the degree of palmation of the feet; the acute canthus rostralis distinguishes it from the *B. politus*. I dedicate it to my friend Miss Sarah P. Monks, of Cold Spring, New York, who has paid especial attention to the cold blooded vertebrata of North America.

5. *Spea hammondi* Baird.

Several specimens. This species was also brought from Chihuahua by John Potts, so that its range is shown to be wide. Nos. 9881, 4–5, 9915.

6. *Hyla eximia* Baird. Nos. 9875, 9898.

7. *Hyla arenicolor* Cope. Nos. 9897, 9916.

8. *Malachylodes guttilatus*, gen. et sp. nov.

Char. gen. Mostly like *Syrrhophus* and *Phyllobates*, but with a frontoparietal fontanelle as in *Liuperus*. Nasal bones wide, in contact on the middle line. Vomerine teeth none. Toes free, no tarsal spurs.

This new genus is of interest as exhibiting the lowest station in the series which is typified by *Hylodes*, excepting that the nasal bones are not so reduced as in the type of *Phyllobates*. The presence of the fontanelle places it nearer to *Hylorhina* than any other of this group, and allies it to the *Liuperine* division; but its xiphisternum is a thin cartilaginous plate, and the terminal phalanges support a transverse piece as in the *Hylodinæ*.

Char. specif. Head flat and rather wide, with an oval muzzle. Canthus rostralis not well marked. Eye not prominent nor large, its diameter equal distance from its anterior border to the nostril. Muzzle not overhanging. The heel reaches the posterior border of the orbit, and the wrist reaches the end of the muzzle. The foot is rather short, and the terminal dilatations are small. Tarsal tubercles insignificant. Skin without folds, smooth, except some small tubercles on the eyelids, and a trace of areolation on the posterior part of the sides and abdomen.

* *B. levifrons* Brocchi; Bullet. Société Philomathique, Paris, 1877, 13 (Extract).

Color above dark mulberry-brown with numerous, very faint small pale spots. On the sides the ground color becomes paler, and the light spots much more distinct. Limbs banded with rufous. Lower surfaces uniform yellowish.

Length of head and body, .022; of head to angle of jaws, .007; width of head at angle, .009; length of hind limb, .030; length of hind foot, .014. No. 9888.

This species has some resemblance to the *Syrrhophus leprus* from Tehuantepec.

9. *Cystignathus microtis*, sp. nov.

Like all the Mexican species of this genus, this one has short series of vomerine teeth behind the posterior nares, and a discoidal fold of the abdominal integument. It differs from the *C. melanonotus* Hallow, in not having a dermal margin of the posterior digits. The dorsal skin does not present any glandular folds such as occur in *C. labialis* and *C. gracilis*. The muzzle is not elongate, and is convex in transverse section, the canthus rostralis being absent. The limbs are very stout, especially the femur, as in *C. melanonotus*, but not elongate, the heel only reaching the posterior border of the orbit. The eye is not large, and the tympanum's diameter is only two-fifths of its length, a characteristic peculiarity of the species.

Color above dark brown, with a blackish pale edged triangle between the eyes, with its apex directed posteriorly. A dark light edged spot below the front of the orbit. Tympanum and a streak behind it, blackish. No light stripe on the upper lip. Belly dirty white gray, marbled anteriorly. Throat dark brown; limbs light brown below.

Length of head and body, .028; length of hind leg, .038; length of hind foot, .020; length of head, .009; width of head behind, .009.

Three specimens. Nos. 9906, 9908–9.

10. *Rana montezuma* Bd. No. 9891.

11. *Rana halecina* Kahn. *var.* No. 9900.

LACERTILIA.

12. *Sceloporus dugesi* Bocourt. Nos. 9886, 9893, 9904–5.

13. *Sceloporus formosus* Wiegm. *var.* Nos. 9876, 9878.

14. *Sceloporus torquatus* Wiegm. *var.* 9877.

15. *Sceloporus spinosus* Wieg. Eupataro.

16. *Sceloporus grammicus* Wieg. Eupataro.

17. *Holbrookia maculata* B. and G.; sub-species *approximans* Baird. This is the Mexican form of *H. maculata*, and has not been found within the limits of the United States. Nos. 9894, 9903.

18. *Cnemidophorus communis* Cope. Nos. 9879, 9882–7, 9901–2.

OPHIDIA.

CONOPSIS NASUS Gthr.

19. *Ogmius varians* Jan. (*Oxyrhina*) *Ogmius* Cope, Proceed. Amer. Philos. Soc. 1869, p. 162. No. 9913.

20. *Adelophis copei* Duges MS., gen. et sp. nov.

Char. gen. Allied to *Tropidoclonium*. Scales keeled; anal single;

caudal scutella two-rowed. Teeth equal. Cephalic shields normal. Nasals distinct, and separated by a space from the single preocular, which is occupied by the prefrontal, since the loreal is wanting. Head little distinct from body. Rostral plate not produced. The absence of loreal plate is the only character that separates this genus from *Tropidoclonium*.

Char. specif. Total length, 33 centimetres; tail very acute and terminating in a cone; length of tail, M.0.066. Cephalic scales convex; dorsals and supra-caudals carinate, those on the flanks smooth. Urosteges divided; a single preanal. A single preocular and two post-oculars; temporals three (1 + 2). Superior labials five, the first in contact with the two nasals and the rostral; the second is in contact with the posterior nasal and fronto-nasal; the third is in contact with the fronto-nasal, the preocular and the eye; the fourth is in contact with the eye and the inferior post-ocular; the fifth and largest is in contact with the inferior post-ocular, the first temporal and the inferior temporal of the second row. There are two nasals; the nostril piercing the posterior border of the anterior one. The rostral projects very slightly above the level of the muzzle. No frenal, the fronto-nasals extending on the sides till in contact with the superior labials. The internasals are small, triangular. The frontal or vertical is much longer than wide, and is six-sided. Palpebrals (supra-oculars) are elongated, straight; occipitals large. Five inferior labials on each side, and a small mental. Four elongate inframaxillaries, the extremity of the posterior ones angulated and separated by two small gulars. Three rows of gulars on each side.

I have counted fifteen dorsal rows of scales longitudinally; the rows in contact with the gastosteges the largest and smooth, those on the back and upper side of tail carinated, rhombic and truncated (emarginate) at their extremities. The preanal is undivided.

On the middle of the back there is a yellowish line extending from the occiput to the commencement of the tail, which embraces two rows of scales. On each side of this line a chestnut-brown band of the same width as the former, which is bordered below by a black line; the line is lost in the tail, and behiud the eye it forms an elongate black spot. The flanks and belly are light brown; there is a black line on the posterior margin of each of the scales in contact with the gastrosteges; towards the tail they disappear. The upper side of the head is chestnut and the lips are like the flanks in color, very yellow.

Habitat, Guadalajara, Mexico.

21. *Phimothyra bairdi* Jan., 9883.
22. *Lytorhynchus mexicanus* D. & B. *Zamenis* D. & B. Eupataro.
23. *Bascanium tæniatum laterale* Hallow.
24. *Eutænia cyrtopsis* Kenn, 9892.
25. *Eutænia sirtalis* Linn., 9899.
26. *Hypsiglena ochrorhynchus* Cope, 9889.
27. *Trimorphodon upsilon* Cope, 9911–12.

Elaps fulvius L.

28. *Crotalus polystictus* Cope. *C. triseriatus* Jan. nec. Wagler. *C. ximenesii* Dugés.

REMARKS.

Points of interest in geographical distribution, indicated by the collection of Dr. Dugés, are the following: The species of the above list which belong distinctively to the Sonoran district fauna are five, viz: *Bufo punctatus, Hyla arenicolor, Spea hammondi, Eutænia cyrtopsis, Hypsiglena ochrorhynchus.* Besides these genera, the following belong to the Nearctic Realm, and not to the Neotropical: *Rana, Sceloporus, Holbrookia, Phimothyra, Bascanium. Cystignathus* is the only Neotropical genus; while *Malachylodes, Ogmius, Canopsis* and *Trimorphodon* are especially Mexican.

I add that Dr. Dugés has sent *Hypopachus variolosus* Cope, from the State of Guadalaxara, a species heretofore only known as Costa Rican.

III. TEHUANTEPEC, Sumichrast.

A list of species from this locality and collector was published in the Proceedings American Philosophical Society for 1869, p. 161. Since that date a number of collections have been sent by Mr. Sumichrast, which add materially to our knowledge of the distribution of the Batrachia and Reptilia of the district of Mexico properly so called. I append Mr. Sumichrast's notes.

BATRACHIA.

1. *Œdipus rufescens* Cope, 10042 (15). Heretofore only known from Vera Cruz. Found in tufts of *Tillandsia.*
2. *Œdipus carbonarius carbonarius* Cope.
2. *Œdipus carbonarius salvini* Gray.
3. *Siphonops mexicanus* D. & B.
4. *Bufo agua* Daud.
5. *Bufo sternosignatus* Gthr., 10014 (No. 2). Only found in the beginning of the rainy season breeding in pools.
6. *Bufo canaliferus* Cope, 10015, 10022 (No. 3). Found in woods, and not seen in pools at the breeding season.
7. *Bufo coccifer* Cope.
8. *Bufo valliceps* Wiegm., 10013 (No. 1).
9. *Microphryne pustulosa* Cope, 10023–8.
10. *Engystoma ustum* Cope, 10021.
11. *Rhinophrynus dorsalis* D. & B.
12. *Hyla miotympanum* Cope.
13. *Smilisca baudini* D. & B., 10016 (No. 4). Abundant, but only seen in the rainy season, when it comes to pools, lagoons, etc., to breed.
14. *Hylella platycephala*, sp. nov.

This species conforms to the characters of the genus *Hylella*, as I understand them, viz: in the general structure of *Hyla*, including fronto-parietal fontanelle and narrow divergent nasal bones, but wanting vomerine teeth.

The present species is not large and has elongate hind limbs, the heel reaching the middle of the orbit. The sole of the hinder foot is rather

short, not exceeding the length of the astragalus more than the fifth of its own length. The digital dilatations are well developed on both extremities; the posterior digits are two-thirds webbed, while the anterior are scarcely one-fourth palmate. The species is particularly characterized by the abbreviation and flatness of the head, which is also wide. The canthus rostrales are distinct and very convergent; the muzzle is truncate vertically, but projects a little beyond the mandible. The nostrils are terminal and lateral, and are as far anterior to the eye as the long diameter of the latter. The latter dimension is four times the diameter of the tympanum, and is equal to the interorbital width. The skin of the superior surface is everywhere smooth. The thorax, belly and inferior face of part of femora are areolate.

The color in spirits is light ashen above, rather darker on the head. Canthus rostralis dark shaded. Inferior surfaces light orange. No markings on the sides or concealed faces of the limbs, nor on the superior faces of the limbs.

Length of head and body, .083; length of head to angle of jaws, axially, .007; width of head posteriorly, .011; length of fore limb, .015; of hind limb, .045; of hind foot, .019.

This is the first of the genus detected in the Mexican district. It is larger than the *H. carnea* Cope, of Brazil, has a weaker palmation of the fingers, and more uniform coloration.

From Japana, from an elevation of from 2000 to 3000 feet. It is found in the tufts of epiphytic *Tillandsiæ* and M. Sumichrast thinks it undergoes its metamorphoses there, in rain-water held in the axils of the leaves.

15. *Lithodytes rhodopis* Cope, 10020 (No. 8).

16. *Lithodytes podiciferus* Cope.

17. *Syrrhophus leprus*, sp. nov.

The genus *Syrrhophus* was proposed by me in 1878* to receive frogs allied to *Phyllobates*, but with largely developed nasal bones, which meet on the middle line, as in *Hylodes*, thus covering the ethmoid cartilage. The typical species is the *S. marnochii* of West Texas; a second species is the *S. cystignathoides* Cope,† and the present frog increases the number to three. These species are distinguished as follows:

Posterior limbs short, heel to tympanum; head wide; tympanum half orbit; rufous, brown spotted ..... *S. marnochii.*

Posterior limbs longer, heel to front of orbit; head wide, a canthus rostralis; tympanum one-third orbit; brown, pale spotted..... *S. leprus.*

Posterior limbs longer, heel to front of orbit; head narrow, no canthus rostralis; tympanum one-third orbit; brown, dark spotted, *S. cystignathoides.*

In the *S. leprus* the muzzle is broadly acuminate and obtuse, with vertical profile; nares lateral and terminal, and as far from the orbit as the diameter of the latter. Lores vertical. Eye not prominent upwards.

* American Naturalist, p. 253.

† *Phyllobates*, Proceed. Am. Philos. Soc., 1877, p. 89.

Choanæ and ostia pharyngea small and equal; tongue obpyriform and entire. The digital dilatations are small, and the inferior tubercles of the digits are well marked both anteriorly and posteriorly. A large palmar tubercle; solar tubercles weak. The hind foot is rather slender, the solar part equaling the tibia in length. Skin everywhere smooth.

All the superior surfaces, including limbs, a dark mulberry-brown, dotted with moderately large gray spots; below a pale pinkish-brown (in spirits), without markings. Lores and upper lip like the back.

Length of head and body, .024; of head to angle of jaws (axial), .008; width of head at angle of jaws, .009; length of hind limb, .035; of hind foot, .010.

From Santa Efigenia. No. 10040 (No. 14). Found in woods. According to Mr. Sumichrast, the dorsal spots are yellow in life.

18. *Cystignathus melanonotus* Hallow.

19. *Cystignathus perlævis*, sp. nov.

The species of this genus are numerous, and difficult to distinguish. They fall naturally into groups defined by the form of the series of vomerine teeth, and the presence or absence of a discoidal fold of the abdominal integument, and of membranous margins to the posterior digits. The latter character does not suffice for the discrimination of a genus, hence I regard *Tarsopterus* R. & L. as synonymous with *Cystignathus*.

The species of the Mexican district of the Neotropical Realm all have a discoidal abdominal fold, and the vomerine teeth in short transverse series behind the line of the posterior boundary of the choanæ. I know but one species which has dermal digital margins. The species are distinguished as follows. I premise that the presence or absence of spots is not constant among them:

I. Posterior digits with dermal margins.

Dermal glandular folds numerous, generally broken up; legs stout, heel reaching orbit; tympanic membrane .66 of eye; no light stripe on lip ..... *C. melanonotus.*

II. No digital dermal margins.

No glandular folds; legs slender, heel reaching front of orbit; tympanum .66 of orbit; no light lip stripe ..... *C. perlævis.*

Glandular folds (?) none; legs very robust: heel reaching orbit; tympanum .4 of orbit; no stripe on lip ..... *C. microtis.*

Glandular folds present; legs short, reaching orbit; tympanum equal orbit; lip stripe imperfect ..... *C. gracilis.*

Glandular folds; legs long, reaching front of orbit; tympanum .6 of orbit; a lip stripe ..... *C. labialis.*

The *C. perlævis* is characterized by its exceedingly smooth and shining skin, which is entirely without the glandular ridges usual in the genus. The head is angular oval in outline with distinct canthus rostrales, which are near together, and much within the labial outline. The muzzle projects a little, and the nares are about one-third the distance from its apex to the orbit. Tongue a longitudinal oval, entire behind; choanæ rather

small and equal to the ostia pharyngea. The vomerine series are well separated from each other and extend but little external to the inner border of the nares. Vertical diameter of tympanic disc a little less than the horizontal. Second and fourth fingers equal; the first a little longer. The posterior foot is slender, and the solar portion is as long as the tibia and half of the astragalus. Solar tubercles insignificant.

Dark ashen gray above, sides blackish above, speckled with white and blackish below. An interorbital dark spot; upper lip marbled; posterior face of femora dark, with light specks. Below white, the sides gray marbled. Throat gray, white spotted. Posterior limbs obscurely cross-banded above.

Length of head and body, .038; of head axially to angle of jaws, .014; width at latter point, .0135; length of hind limb, .055; of hind foot, .028.

Taken from a well near Japana. 10041. (No. 16, F. S.)

20. *Cystignathus gracilis* D. B. 10018–9. (No. 6–7.) Found under old logs and stones, near water.

21. *Cystignathus labialis* Cope, Proceeds. Amer. Philos. Soc. 1877, p. 90.

The original description of this species was taken from young specimens in which the posterior limbs are not as long as in adults. Numerous specimens from Tehuantepec, which fix the characters and locality. There are also three specimens sent by M. Sumichrast, from Potrero, near Cordova, Vera Cruz.

22. *Ranula affinis* Pet. (No. 5, F. S.) Rather common in pools and rivulets. It grows to a large size, when the dorsal markings become obsolete.

Rana halecina Kahm, *var.* with indistinct dorsal spots.

Some varieties of this species from its extreme southern range, look quite different from the typical form. The dorsal green becomes more vivid, and has sometimes a blue shade on the head. The spots become obscure, and there is a general resemblance to the *Ranula affinis*. It may be distinguished from that frog by the less palmation of the toes, which are without apical callosities, and by the presence of dermal folds between the dorso-laterals, although these are sometimes faint. The most aberrant examples come from Coban, Vera Paz.

Lacertilia.

24. *Epaphelus sumichrasti* Cope.
25. *Mocoa assata* Cope.
26. *Celestus chalybæus* Cope.
27. *Cnemidophorus microlepidopus* Cope, Proceed. Amer. Philos. Soc. 1877, p. 93.
28. *Cnemidophorus unicolor* Cope, l. c. 93.
29. *Cnemidophorus immutabilis* Cope, l. c. 93.
30. *Cnemidophorus lativittis* Cope, l. c. p 94.
31. *Amiva undulata* Wiegmann.
32. *Lepidophyma smithii* Bocourt.

OPHIDIA.

33. *Stenostoma phænops* Cope, Journal Academy Philadelphia, 1875, p. 128.
34. *Loxocemus bicolor* Cope.
35. *Geagras redimitus* Cope, Journal Academy Phila., 1875, p. 141.
36. *Ficimia olivacea* Gray.
37. *Tantilla rubra* Cope, loc. sup. cit. 144.
38. *Conophis sumichrasti* Cope, loc. cit. 137.
39. *Coniophanes proterops* Cope, l. c. 138.
40. *Coniophanes fissidens* Gthr. l. c. 138.
41. *Spilotes corais melanurus* D. and B.
42. *Bascanium mentovarium* D. and B.
43. *Leptophis diplotropis* Gthr.
44. *Dryophis fulgidus* Daud.
45. *Himantodes cenchoa* L.
46. *Oxyrrhopus clelia* L.

REMARKS.

This catalogue represents a part of the Mexican fauna properly so-called. There is not a single non-Neotropical genus excepting *Rana* and *Bascanium*. Of the remaining thirty genera, fifteen are characteristically Neotropical; twelve are peculiarly Mexican, two are cosmopolitan or nearly so, and one (*Celestus*) is West Indian.

IV. COSTA RICA, Zeledon.

This collection includes a number of species which I have named in my monograph on the Herpetology of Costa Rica,* with some additional ones. I now give the names of the latter only, enumerating them from the end of my former list.

3. *Œdipus morio* Cope. Inserted in the essay above cited as doubtfully occurring in Costa Rica. From Cartago on the Plateau.

45. *Coleonyx elegans* Gray. Inserted in my list on the authority of Peters. Zeledon's collection contains fine specimens, which he states were found in ant hills on the table land near San José.

131. *Scolecophis zonatus* Hallow.

132. *Coluber triaspis* Cope. The Plateau near San José. The most southern locality for this species and genus.

133. *Porthidium nasutum* Bocourt.

From Limon, on the East Coast. This species is very near the *Bothriopsis proboscideus* Cope, and may not prove to be distinct from it. In the latter there are two nasal plates, the supranasals are longer, more concave on the external edge, and more widely separated than in *P. nasutum*, and the frontal scales are carinate. They are smooth, or nearly so, in Mr. Zeledon's specimen, which also has the rostral plate a little shorter than in the *B. proboscideus*. The specimens of the latter are smaller than the single *P. nasutum*. It is questionable whether a large series will sustain

*Journal Academy Philadelphia, 1875, 93.

these characters. In *P. nasutum* the scuta are, 136–27; in *B. proboscideus*, 132–31.

V. San Domingo, Drs. Brown, Fraser and Gabb.

A few of the species of the collection made by Dr. Brown are from the Island of Gonave, off the West Coast of Santo Domingo; the others are from near Port-au-Prince.

Batrachia.

1. *Trachycephalus marmoratus* D. and B., Fraser and Gabb. Puerto Plata.

2. *Hylodes martinicensis* D. and B., Gabb and Fraser.

Lacertilia.

3. *Celestus rugosus*, sp. nov.

Scales in thirty-six longitudinal rows; each with a strong median keel, and seven or eight weaker ones on each side of it, making fifteen or seventeen in all. The median keels are strong and continuous from the nape, becoming stronger posteriorly, especially on the tail, whose superior and lateral surfaces are thus thrown into gutters. In the specimen the distal part of the tail is lost. The keels form oblique lines over the sides; they are strong on the hinder and weaker on the anterior limbs.

The general form is slender, and the limbs are quite weak; the latter when extended along the side fail to meet by the length of the posterior foot and leg to the knee. The head is flat and rather elongate, and its scuta are normal. There are nine superior labials, of which the eighth is the first one angulated above. Both the loreals are rather higher than long. Five supraorbitals, the posterior separated by two scales from the parietal. Interparietal large as parietal; a large post-interparietal. Five pairs of large infralabials, which are separated from the labials by scales.

Ground color gray; no longitudinal lines, but the nape and back are crossed by seventeen brown cross-bars, which are nearly in contact medially, and taper to disappearance on the upper part of the side. Their dorsal portions are sometimes confluent longitudinally. A series of faint dusted brown spots on the inferior part of the sides. Below, white, with a few scales here and there brown. Limbs brown above.

Length from end of muzzle to vent three and a half inches; from do. to middle of auricular meatus five-eighths of an inch; from do. to axilla one and five-eighths inch.

From Puerto Plata, Santo Domingo. Charles A. Fraser. No. 10260.

This species is quite distinct from those previously known in both squamation and color.

4. *Celestus stenurus* Cope, var. Proceedings Academy, Philadelphia, 1868, p. 126. Puerto Plata. Fraser.

5. *Celestus phoxinus* Cope, Gabb.

6. *Sphærodactylus alopex* Cope, Fraser.

7. *Anolis cœlestinus* Cope, Gabb.

8. *Anolis semilineatus* Cope, Gabb.
9. *Anolis cybotes* Cope, Gabb and Fraser.
10. *Anolis distichus* Cope, Gabb, Fraser. Puerto Plata.
11. *Liocephalus trigeminatus* Cope, Fraser. Puerto Plata.
Eupristis ricordii D. & B., Gabb and Fraser.
Amphisbæna innocens Weinl., Gonave Island, Brown.

OPHIDIA.

12. *Typhlops lumbricalis* D. B. Puerto Plata. Fraser.
13. *Ungualia hatiana*, sp. nov.

Scales in twenty-seven rows, entirely smooth. Body stout, head not distinct, tapering; eye small, its diameter less than one-third the length of the muzzle in front of it. Internasals longer than wide; internasofrontals and prefrontals much wider than long. Parietals as long as frontal, in contact medially. Superior labials 9–10; only those in front of the orbit higher than long. Oculars 1–3, fourth and fifth labials entering orbit. Gastrosteges 192; urosteges 32.

Color brownish-ashen above, with four rows of alternating round blackish brown spots, of which the median are larger and become confluent at some parts of the body. Another row of dark spots on the inferior part of the side, which are separated by yellowish scales. An additional row of larger spots alternating with these involve the ends of the gastrosteges, and may or may not meet across the middle line of the abdomen.

Total length, .680; of rictus oris, .017; of the tail, .075.

This, the largest species of the genus, much resembles the *U. maculata* of Cuba, etc., but it has a larger number of scales, and also exceeds it materially in the number of gastrosteges. Its smooth scales distinguish it from the *U. melanura* and *U. pardalis*.

From Port-au-Prince and Gonave Island, Dr. Brown. No. 10164. Puerto Plata. Fraser.

14. *Homolochilus striatus* Fisch. Frazer.
15. *Dromicus parvifrons* Cope, Gabb. Puerto Plata. Fraser. A variety was found on Gonave by Dr. Brown. In two specimens the ground color is black, and the belly is white; a light olive color extends on the sides as far as the third row of scales. Belly not spotted as in the usual variety.
16. *Hypsirhynchus ferox* Günther.

Dr. Brown, Port-au-Prince. These specimens agree exactly with Dr. Günther's description, and differ from the *H. scalaris* Cope, in the presence of a loreal plate and the triangular form of the dorsal spots. Although I have united these supposed species, I now incline to believe them distinct.

17. *Jaltris dorsalis* Güthr., Gabb.
18. *Leptophis catesbeyi* D. and B., Gabb. Puerto Plata. Fraser.
19. *Leptophis oxyrhynchus* D. and B., Brown.

CROCODILIA.

20. *Crocodilus americanus* Seba, Fraser. Puerto Plata.

VI. Dominica, Ober.

As no study of the herpetology of this island has been made, the following list of five species partially supplies a deficiency in our knowledge.

1. *Mabuia cepedei* Gray.

2. *Xiphosurus oculatus*, sp. nov.

Abdominal scales smooth, those of sides and back minute: two median dorsal rows a little larger, keeled, and elevated on a moderate simple dermal fold which extends to the head. Superciliary scales separated by one or two rows of scales, and widely removed by scales from the small occipital. Muzzle rather long, flat above; ridges not prominent, covered with large scales, and separated by a shallow concavity, which contains in front, four rows of smaller smooth scales. Six or seven loreal rows; three large infralabials, the first smaller than each symphyseal. Supraorbitals surrounded with granules, consisting of three inner scales the largest, five in the inner row smaller, and six in the external row the least, all nearly smooth. Occipital concavity not profound or sharply defined posteriorly. Scales of arm and posterior leg keeled. Caudal spines well developed in the male.

Color above brownish-ash, with numerous white spots which sometimes form vertical lateral bands, and a white band extending from above the axilla to the middle of the side or beyond. Above this band, on the anterior half of the side are two round black spots, each of which has a white spot in the center. A white band from upper lip to side of nape; lip brown spotted, inferior surfaces dirty white, face yellow posteriorly. Tail uniform.

Total length, .185; of head and body, .072; of head to angle of mandible, .021; width at latter point, .008; length of fore limb .032; of hinder limb, .055; of posterior foot, .025.

The animal which I suppose to be the male, generally has one row of scales between the superciliaries, while the female has two, and has no caudal crest. The color differs in being brown, without the lateral white band or black eye-spots. The white spots form vertical series on the sides. It is possible that this is a different species, but it is in general identical with what the female of the *X. oculatus* should be.

This species differs from its nearest ally, the *X. cristatellus*, in having the superciliary plates separated on the middle line, by the shallow occipital depression, the longer muzzle, and in coloration.

Evidently abundant on the island. Nos. 10139-48, 10150-1, 10153.

3. *Aporophis* julia* sp. nov.

Resembles the *Opheomorphus meleagris* Shaw (*Liophis merremii* D. and B.), but has the long tail of the genus *Aporophis*, this member entering the total length 3.4 times. Appropriately, the number of the urosteges is considerably in excess of that found in the longest tailed varieties of *O. meleagris*, where, according to Duméril and Bibron, they do not exceed 63. They here number 83, and the gastrosteges are 158.

The scales are in seventeen rows, and are rather wide, and are as in other species of *Aporophis*, poreless; nevertheless there are a few on the

*Cope, Proceed. Amer. Philos. Soc. 1877, p. 18. *Lygophis* olim.

sides posteriorly with a single apical pore. Rostral plate small, not produced; nasals subequal; loreal high as long; preocular not reaching frontal. Two postoculars; temporals 1+2+3; the first and second bounding the parietals large and subequal. Superior labials eight, fourth and fifth entering orbit. Inferior labials ten, six in contact with genecials. Pairs of genecials equal. Frontal with straight sides, longer than wide in front, equal occipital.

Ground color above black, each scale with a round yellow spot near the base, including the first row, and excepting a row on each side of the vertebral row, which is uniform black (with an occasional spot) for the posterior third of the body. A median dorsal black line on tail. Ground color of head above brownish-yellow; a black band through eye, which sends branches along the borders of the labials; a black spot on top of muzzle; a black cross band between eyes, and the greater part of each parietal plate black.

Total length, M. .640; tail, 190.

This handsome species is named for my daughter.

4. *Alsophis sibonius*, sp. nov.

This species does not conform exactly to the diagnosis of the genus *Alsophis*, which I gave in 1862,* since the tail is less than one-third the total length, not much exceeding one-fourth. It thus approaches *Liophis*, and the question of reference to one genus or the other is left to depend on the character of the scale pores. These have the full number common to the species of *Alsophis* and the ground Colubrine snakes generally, while in *Liophis* there is but one on each scale, as in many Coronelline and water snakes.

The physiognomy of the *A. sibonius* is much that of species of the *A. antillensis* type, but the coloration resembles that of the common South American *Sibon annulatum*. The scales are thin and are in nineteen longitudinal series. Gastrosteges 191; anal double; urosteges 118. Total length, .640 M.; tail, .200. Eight superior labials, the third, fourth and fifth entering the orbit, the part of the third contributing being small. The muzzle projects above and is obliquely truncate below; the rostral plate is flat and barely appears on the superior surface of the head. Postnasal higher than prenasal; loreal longer than high, the superior border straight, not angulate. Preocular not much elevated, not reaching the frontal. Postoculars small; temporals 2–2–4. The superior temporal of the first row larger than the others and in contact with the inferior postocular only. The inferior temporal adjoining it does not reach the postoculars, and is, in fact, a dismemberment of the seventh superior labial, which is, in consequence, reduced to a very small size. This arrangement is identical on both sides of the head. Inferior labials ten, six of which are in contact with the genecials; latter subequal. Top of head flat, and orbits not prominent. Lengths of internasals and prefrontals on median suture equal. Frontal longer than wide, the superciliary borders but little

* Proceedings Academy Philadelphia, February.

concave. Occipitals short and wide for the genus; each is bounded posteriorly by a single large temporal plate behind the anterior one on each side, which are only separated on the median line by a small scale.

The ground color in spirits is straw-color. The dorsal region, between the fourth row of scales on each side, is occupied by a series of large rounded brown spots, whose borders are almost in contact on the median line. There are forty-two between the nape and the vent. Occasionally two or more of them are confluent on the middle line. Below and between them the sides are brown shaded, the shade assuming the form of spots anteriorly. Head brown, with a pale spot on each side of the nape; a brown spot with darker borders passes from the muzzle through the eye, and joins the brown dorsal spot on the nape. All the colors become darker posteriorly. Inferior surface unspotted anteriorly; it is sparsely dusted with brown on the posterior half of the body, and the caudal scutella are dusted most densely along the middle line, forming a stripe.

No. 10138 Mus. Smithsonian.

VII. Tobago, Ober.

Amiva surinamensis tobaganus, sub-sp. nov.

A single *Amiva* from Tobago forms a strongly marked race of the common continental species, but whether separable as a species or not I am not yet able to state. It differs from the typical *A. surinamensis* in color, in a disposition to a somewhat greater subdivision of the scuta of the limbs and belly, and in the greater length of the posterior foot. There are twelve rows of abdominal scales at the middle, as is sometimes seen in *A. surinamensis*. The two inner rows of antebrachials extend to the wrist; only one row extends so far in *A. surinamensis*. Both brachial and postbrachial scales, as well as those of the gular fold are rather more numerous than in *A. surinamnesis*. In the latter species the length of the posterior foot equals the distance from the axilla to the middle of the loreal plate; in the form *tobaganus* the foot is as long as from the axilla to the end of the muzzle.

Color olivaceous, with a black lateral band with undulating edges, which are not light bordered, but which are marked by small yellow spots at regular distances. Back with a chain-like series of black annuli on each side, each ring with an obscure yellow spot in its center. Sides black and yellow-spotted; below uniform straw-colored; head uniform brown, lips lighter.

No. 10113; size less than that of the adult *A. surinamensis*.

Anolis alligator D. and B.

Drymobius boddærtii Seetzen.

Bothrops lanceolatus Merr. (Fer de lance.)

Scales in thirty-one and thirty-three longitudinal rows; colors pale, with the cross bands obscure, as in other West Indian specimens.

Hylodes martinicensis D. and B. No. 10121.

The Island of Tobago is, of the Lesser Antilles, the nearest to Trinidad,

Fig. 1.

Fig. 2.

Fig. 3.

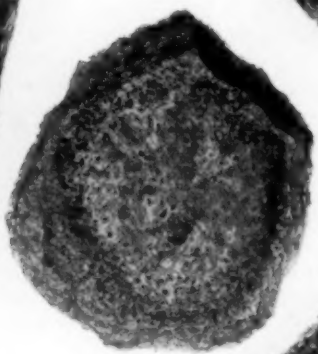


Fig. 4.

Fig. 5.

Fossils (?) from Lancaster County,
near the Maryland State Line.

and it might, on this account, be anticipated that its fauna would present a larger representation of continental types than the more northern islands of the series. That this is the case is shown by the present very limited list, which includes two Brazilian species of the genera *Amiva* and *Drymobius*. None of the species of the Dominica list were found on Tobago by Mr. Ober.

VIII. Northern Bolivia, Orton.

Among the collections sent by Prof. Orton to Philadelphia before his departure for the Beni River, was a collection of reptiles from La Paz, on the eastern slope of the Andes, in Western Bolivia. This city, as is well known, is situated a short distance above the forest line, and enjoys a temperate climate.

In packing, some specimens from Puno, on Lake Titicaca, were mixed with those from La Paz. As reptiles are rare at that elevated locality it is probable that most of the species enumerated were derived from the latter place.

Bufo spinulosus Wiegm.

Oxyrrhopus doliatus D. and B.

Aporophis tæniurus Tsch.

Bothrops microphthalmus Cope, Journal Academy Philadelphia, 1875, p. 182.

Scales in twenty-one longitudinal rows, all carinate excepting the first row, the keels not unusually prominent, and not reaching the apex of the scale. The second labial scute bounds the maxillary fossa in front, but it is partly cut off by suture on both sides.

In the above characters the single specimen of the collection differs from the type. The latter is large, the present individual is small, and the less development of the keels of the scales is perhaps due to immaturity. The scales on the top of the head are larger than in other species of the genus but not so large as in the type. The superciliaries are wide as in it, and there are only seven superior labials. The color of the inferior surface is, anteriorly, mixed black and gray, posteriorly black.

Fossil (?) Forms in the Quartzose Rocks of the Lower Susquehanna. By Persifor Frazer, Jr. With a plate.

(*Read before the American Philosophical Society, April* 4, 1879.)

The forms which accompany and illustrate this paper are found in a hard quartzose greenish rock, difficult to name, which forms part of the left border line of the great river in Cecil County, Maryland, just below the Pennsylvania line.

By a mistake (not the fault of the writer) in the title, the figures are given as from Lancaster county, Pennsylvania. In reality the discoverer of these curious and as yet unexplained phenomena, Dr. C. H. Stubbs, of Fulton

Township, Lancaster Co., found them all in one locality, viz: Frazer's Point, a headland in the river about half a mile below Mason and Dixon's line.

Two of the original specimens have been submitted in turn to Prof. Whitfield, of the New York Museum; Prof. Jas. Hall, State Geologist of New York, and Dr. Joseph Leidy, of this city.

Letters from the first two are found below. Dr. Leidy expressed no definite view.

In the face of the inability of such eminent authorities to determine anything in regard to these objects, I feel reticence to be but the part of sound wisdom. I will only add that these have been very faithfully and accurately delineated of actual size by the artists, Mr. Faber and Mr. Tuthe. (The latter transferred all the drawings to stone, besides making the original sketch of No. 1.) The horizon whence these were taken is believed to have been that immediately under the Potsdam, but in no case can be ascribed to one more recent than the latter formation.

A partial analysis by the undersigned of the very thin film out of which one of these forms, not here represented, was made, here follows. Amount obtained for analysis 0.0562 Gram:

Moisture	2.13
Silica	57.11
Iron Sesquioxide	4.93
Alumina	7.52
Lime	5.93
Magnesia	2.88
Sum	80.50
Undetermined and loss	19.50
Total	100.00

The following are the letters from Prof. Whitfield and Prof. Hall, referred to above:

"AMERICAN MUSEUM OF NATURAL HISTORY,
Central Park, 77th street and 8th Avenue,
NEW YORK, OCT. 9, 1878.

"*Dear Sir:*

* * * * * * *

"The articles sent are *not* fossils, nor are they *organic*—but present every appearance of sandstone pebbles of very fine texture. The annulations on the Orthoceras-like specimen" (Fig. 5) "are lines of fracture, and pass across the rock on each side, showing conclusively their nature."

* * * * * * *

"In future I hope you may have better success than in the present instance.

"I remain yours very truly, R. P. WHITFIELD."

"NEW YORK STATE MUSEUM OF NATURAL HISTORY,
ALBANY.

Fig. 5.

"The enclosed material lies, *apparently*, obliquely to the lines of bedding, and the influence of these lines appears to affect or mark the enclosed

piece. It is impossible to say that it is a fossil, nor could a fossil, unless previously silicified, be preserved in a rock so highly metamorphosed.

"I *do not* believe it to have been a pebble. The extremely elongate form and elliptical section would in my opinion preclude that view of the matter.

"Should you ever obtain specimens of which you could spare a thin slice, it would be the best method of determining the nature of the material.

Fig. 4.

"The enclosed material lies apparently in the plane of the bedding or lamination of the enclosing rock. The substance is too thin to give an idea of the full original form, but from its outline I infer that it has been similar to the other specimen" (Fig. 5). "The outline is, in *my opinion*, quite too symmetrical for a pebble, and, while we have no evidence of its organic character, it is not easy to give any satisfactory explanation of its origin.

"The specimens are extremely interesting and others should be sought for. J. HALL."

Since the receipt of the above letters the other specimens have been sent to the writer by Dr. Stubbs.

On Pyrophyllite from Schuylkill County, Pennsylvania. By F. A. Genth.

(*Read before the American Philosophical Society, July* 18, 1879.)

One of the most interesting varieties of pyrophyllite is that from the coal slates of the "North Mahanoy Colliery" (old Silliman Colliery) near Mahanoy City, Schuylkill county, Pa.

It had been mistaken for damourite, until, by chemical analysis, I established its true character.

I am indebted to Mr. Eli S. Reinhold, of Mahanoy City, for specimens and for the following information with reference to its occurrence.

In the bed, known as "Buck Mountain," it is usually found in horizontal seams, parallel with the coal beds, although it occurs at times in irregular seams in other directions. Thus far it has not been found in any of the other beds of the same mine, and only this mine has furnished it, although the bed in which it occurs is worked in other mines. It also is observed as marking or constituting the plant impressions on the coal slates at this locality.

It is found in thin seams of a delicate fibrous structure. At first glance much resembling the serpentine-variety "chrysotile." It seems that this pyrophyllite has been filling up cavities and cracks in the coal slate, and the exceedingly delicate impressions left by the coal plants in the slate are, after their decay, filled up with pyrophyllite material. Then, it is often not thicker than the finest tissue paper, but still shows, when magnified, the fibrous appearance. In larger cracks it seems to have crystallized from above and from below, and the two seams, thus formed, are mostly separated by a thin layer of pyrite in minute crystalline masses, which leave the impressions of their crystals upon the pyrophyllite. Frequently the fibrous pyrophyllite, as well as the pyrite, are coated with a very thin layer, not thicker than the finest tissue paper, of a *scaly* variety of pyro-

phyllite of an almost silver-white color, and of silky lustre.* The thickest seams of the fibrous pyrophyllite, which I have seen, were 9^{mm} in thickness, separated in the middle by a layer of pyrite.

The purest specimens have a white to yellowish-white color, and a lustre between silky and pearly, the latter especially visible when magnified; the fibrous particles show a somewhat laminated structure. Very soft. Spec. Gr. = 2.804.

Infusible, but strongly exfoliating when heated, leaving a mass of snow-white silky fibres.

Not decomposed by sulphuric nor hydrofluoric acids, nor by a mixture of both.

The analysis made with perfectly pure material gave the composition of pyrophyllite, corresponding to the formula: $Al_2 Si_4 O_{11} + H_2O$.

		Found.		Calculated.
Silicic Acid	=	66.61	—	66.52
Alumina	=	27.63	—	28.49
Ferric Oxide	=	0.16	—	——
Magnesia	=	0.10	—	——
Water	=	5.43	—	4.99
		99.93		100.00

This occurrence of pyrophyllite in coal slates and as the petrifying material of coal plants is exceedingly interesting, and I believe it to be the first time that it has thus been observed.

Prof. Gümpel noticed that a mineral resembling pyrophyllite constitutes the mass of many graptolites, but Prof. von Kobell has shown, by analysis of specimens from Nordhalben, near Steben in Upper Franconia, that this substance is *not* pyrophyllite, but a micaceous mineral, containing over 3% of potassium oxide, which he called "gümpelite."

The petrifying material of coal plants in the Tarantaise in Savoy has also been confounded with pyrophyllite, but we are now indebted to Prof. Gümpel for an investigation of this subject.† His analysis gave 6.803% of potassium oxide and 2.208% of sodium oxide. He has also made an analysis of the mineral of the graptolites from Graefenthal, in Thuringia, which gave 5.06% of oxides of potassium and sodium.

All these analyses show that the substances found as petrifying materials of coal plants in the Tarantaise and of graptolites are *not* pyrophyllite, but varieties, or perhaps mixtures, of micaceous minerals of greater or less purity, belonging to that group, which Prof. Dana puts under the head of *pinite*, and which are so frequently met with in nature as the results of alteration of numerous minerals, such as iolite, nephelite, scapolite, feldspars, staurolite, cyanite, corundum, topaz, &c., &c., which, when pure, would be recognized as damourite, paragonite, &c.

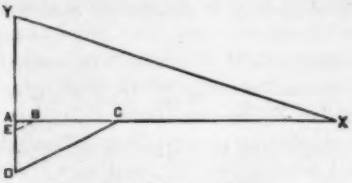
University of Pennsylvania, July 14, 1879.

* I could not get enough of it in a pure state for an analysis, but a partial analysis proved it to be pyrophyllite.

† G. Tschermak, Mineralogische und Petrographische Mittheilungen II, 2, 189.

Approximate Quadrature of the Circle. *By Pliny Earle Chase, LL.D.*

(*Read before the American Philosophical Society, June 20th,* 1879.)



AB = 3; AC = 20
AD = 3 AB; AX = 3 AC
BE parallel to CD
EY = AC
XY = 3.141585 AC

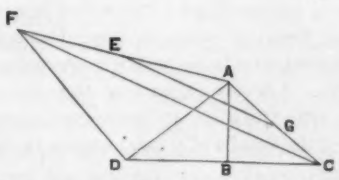
The deviation from perfect accuracy is less than $\frac{1}{41000}$ of one per cent. which would give an error of less than $\frac{1}{6}$ of an inch per mile. For all practical purposes the construction may be regarded as *exact*, for the error would be inappreciable in any mechanical work.

Haverford College, June 16th, 1879.

Note.—July 16, 1879. My attention has been called to the following more-complicated construction, and closer approximation, in Perkins's Geometry (D. Appleton & Co., 1853).

On an indefinite straight line A N, take A B = B D = D E = 1; at E erect a perpendicular E G = 2 A B = 2 E F; on E N take E H = H K = A G, K L (towards A) = A F, L M (towards N) = D G, M N = D F; bisect E N at P, E P at R, A B at C; trisect E R at T. Then C T = 3.1415922.

The author calls this method "very simple," and says, that a better one "can hardly be expected, or even desired." But the approximation of Adrian Metius, $\frac{355}{113}$, is still closer, and the following construction of his ratio is simpler.



On A B = 7 erect the perpendicular B C = 8; extend C B to D, making B D = 9; on A D erect the perpendicular D F = 15; take A E = A C, and draw E G parallel to F C. Then $\frac{AF}{AG} = \frac{355}{113} = 3.1415929$, the true ratio being 3.1415926+.

The error of this construction is less than $\frac{1}{11300000}$ of one per cent. Perkins's error is more than $\frac{1}{7000000}$ of one per cent. Neither method is so simple, nor so desirable for practical purposes, as the one which I communicated to the Society at its June meeting.

Notes on some Land-shells of the Pacific Slope. By J. G. Cooper, M. D.

(*Read before the American Philosophical Society, May* 16, 1879.)

The recent publication of Vol. V of the "Terrestrial Air-breathing Mollusks of the United States," etc., by W. G. Binney, as a "Bulletin of the Museum of Comparative Zoology at Harvard College," forms a fitting occasion for making some further observations, biographical and taxonomic, on the species found west of the "Great Plains," which form the chief boundary within our limits between the eastern and western groups of species.

It is to be regretted that Mr. Binney has *not* had "time and inclination" to improve on the classifications of Albers and Von Marten, which his own original investigations have made quite inadequate to the subject (Preface, p. iii).

The many improvements made on the system adopted in the "Pulmonata Geophila," of Binney and Bland (Smithsonian Misc. Pub., 194, 1869), are very satisfactory, few of the errors there noted being retained in this work, which is to a great extent a republication of that, with additions from other sources, rendering it more complete as a manual of the subject. The bad results of the habit of blindly following foreign authorities is shown in the higher divisions adopted on p. 81, the first, *Agnatha*, being founded on a *negative* character as to the jaw, while those of the lingual teeth are not different in divisions B and C, and all of them show that these parts are insufficient for classification alone, while they lead to far more confusion of distinct forms than divisions founded only on external characters.

The labored investigations of the microscopists into the internal anatomy has at last led to nearly the same results as a comparison of external forms, as far as they prove a close connection to exist between the two groups of characters, and we may hope that the less difficult system of classification by external resemblances will in time resume its former importance, modified and improved by a knowledge of the *entire* structure of the animals. The fallacy of making family divisions to depend on a few internal characters has been often shown, and is becoming more and more certain with increase of investigation. I do not claim that the *shells* alone should guide in classification, but, with the form of the animal, they should define the higher groups, leaving the details of special organs to determine genera and species.

Genus Helix.

Again following his authorities Mr. Binney uses "*Helix*" as a comprehensive term, like Pfeiffer including in it every helicoid land-shell, and like the French naturalists making genera by distintegrating it without leaving a single original Helix. No other genus founded by the immortal Linnæus has so hard a fate, and it is to be hoped that at least *one* species will yet be found to be a Helix.

I have before shown that our west-coast banded group has claim at least to be considered first cousin to the type of Helix, and cannot yet see more than sub-generic differences, supposing *lapicida* to be the type. Mr. Binney, however, while admitting that the shell furnishes the most reliable characters for the division (p. 252), makes it subordinate in most genera, and appears to me to give it too little value.

Sub-genus ARIONTA.

I am more convinced by further comparisons of additional specimens that the group of forms of this sub-genus found around San Francisco Bay are merely local races of one species, the *californiensis* of Lea, running into the var. *nemorivaga* Val. (usually called *nickliniana* Lea, which however was so described as to include several), *bridgesi* Newc., passing into next, *ramentosa* Gld. (nearly = *reticulata* Pf.), and the extreme Monterey race *vincta* Val. (= *californiensis* of Binney).

A specimen from Cedar Mountain, east of San Francisco Bay, found by Dr. Yates, has nearly the form of var. *vincta*, being almost as high as wide, but much dwarfed. Occasional specimens occur within the range of each variety connecting it with some of the others. I suspect that the examination of numerous specimens of each would make the differences in internal characters pointed out by Mr. Binney less uniform than he makes them appear, as he admits much variation in these respects in several species thus examined.

The named varieties of the European *A. arbustorum* are even more distinct than in our group inhabiting the region around San Francisco Bay.

In the only admitted species of the Sierra Nevada, *A. tudiculata*, I have before mentioned that many varieties exist, though less localized and marked, only one having yet been named, the var. *cypreophila* Newc., MSS.; distinguished by thinness and umbilicus. This form, of very small size, was also found by Dr. Yates in 1875, at Shasta, Cal., near lat. 41°, the most northern point at which it has recently occurred. Nor does it pass east of the Sierra Nevada, though lately included in the shells of the Great Basin by Ingersoll, from misunderstanding the locality of "Bear River, Cal.," given by Carlton.

It may yet be proved that *A. arrosa* is but a sub-species of *californiensis*, the varieties *arboretorum* Val., and the later varieties *holderi* and *stiversiana* described by me, forming the connecting links. In that case *A. exarata* Pf. must also fall into the series, being connected with *arrosa* by intermediate specimens, though rare and local. But the very rarity of all these links tends to indicate an original difference in the chief forms, now becoming obscured where they meet in their ranges of distribution. (See Amer. Jour. of Conch., IV, 238.)

In a recent article I have shown by maps the peculiar distribution of the species I refer to, *Arionta* being grouped in narrow limits as compared with the others. (Proc. Cal. Acad. Sc., V, 121, 1873.)

Having now disposed of the Ariontas of the San Francisco group, there remain those of Southern California, and the islands, extending onto the peninsula. I have before shown in various articles that these are all con-

nected by intermediate forms, even that retained by Mr. Binney in genus *Euparypha* (*Tryoni*), the difference in this being merely the result of a greater abundance of lime in its food, and therefore in the shell. It is also not improbable that the species called *Euparypha* from southern Europe, etc., are merely *Arionta* developed under similar conditions. In our species, however, I see no reason for allowing more than specific differences. Specimens of *H. kellettii*, and of var. *crebristriata* may be selected, and are more common fossil, that have just as much claim to be considered *Euparyphæ* (or of other genera) as *Tryoni*. No *single* character, external or internal, will suffice to distinguish genera in this family or order of animals.

A. redimita W. G. Binn. The author of this name now calls it "probably a variety of *A. ramentosa*," relying upon a resemblance in sculpture. But this file-like surface is characteristic of many forms in the young state, and of these species, the island variety first named *redimita*, shows in its form a much nearer approach to *A. kellettii* than any other, and much the same sculpture. The jaws and linguals are also nearer. A variety of *californiensis*, however, comes very near it in form, and was formerly mistaken for it on this coast.

I have before discussed the close gradations between the other southern species of *Arionta*.

Sub-genus CAMPYLÆA?

Retaining this name provisionally, I merely refer to my previous writings for the distinguishing characters between it and *Arionta*. The remarkable differences in the geographical distribution of the species, shown in the maps referred to, is among the most striking of their characters. It is quite probable that more thorough search in intermediate localities will tend to increase the number of connecting links, but as now known the species are more distinct than in *Arionta*, though a regular gradation in characters corresponding with their distribution has been already referred to.*

* With his characteristic devotion to European precedents, even where plainly wrong, Mr. Binney retains the name *Aglaia* (now as a genus) though long ago shown to be preoccupied twice in Mollusca. Besides it was used first for a South American snail of apparently distinct generic characters from ours. But because Albers long ago placed *H. fidelis* in this group, it is retained, with the subspecies or southern race *infumata*, and because the latter has a form like that of *H. hillebrandi*, Mr. Binney has put this also with them, ignoring the fact that this species bears exactly the same relation to *H. mormonum* as *H. infumata* to *fidelis*, and that intermediate specimens are even more common between the two first. *H. mormonum*, however, is an "*Arionta*" according to Mr. Binney!

Now any one with the shells before him can see a regular gradation from *H. hillebrandi* through *mormonum*, *sequoicola*, *dupetithouarsi*, *traskii*, *carpenteri*, *diabloensis*, *ruficincta*, to *gabbi* and *facta*. If one is an *Aglaia*, all are, the differences between this genus and *Arionta* being in the shells, though Binney's description does not make it at all clear. Having before pointed out the distinctive characters (Amer. Jour. of Conch., V, 201), I merely wish here to amend them by stating that I placed *H. carpenteri* in *Arionta* from misapprehension of its true characters, and that *diabloensis* as well as this, is probably a variety of *traskii*, although the form described by Binney as *diabloensis* appears to be a variety of *ramentosa*, of which he does not figure a type. The types, however, show an approach to *Arionta* as I stated in description.

A link connecting *fidelis* with *mormonum* found at the Dalles, Or., seems to me, however, most properly referred to the former. The most northern locality for *mormonum* now known is at Shasta, Cal., lat. 41° (nearly), alt. 1160 feet, where in the volcanic region Dr. Yates found a very few stunted specimens with but five and a half whorls and the bristle-granulations of the young very strongly developed.

H. dupetithouarsi Desh. The figure copied by Binney from Deshayes, if accurately drawn, is larger than any Monterey specimen I have seen, although Deshayes gives that as the locality. It also has two black bands alternating with three light ones, thus appearing more like the variety of *fidelis* with a light upper surface, while the character "lighter above," also suits that rather than the Monterey shell. As Dupetithouar's expedition visited Oregon, I suspect that Deshayes really figured a *fidelis* as a better example of the species, not having seen Gray's nor Lea's then recent descriptions, just as he overlooked Conrad's of marine species collected by Nuttall in California.

Still as he gives only Monterey as the locality, the name had better remain with that species which the description suits (with the exceptions here noted in color and size).

This confusion may account in some degree for authors confounding with this species others from distant points, and thus giving it an enormous instead of very limited range. Some late authors have also obtained it at second hand from amateur collectors on this coast, who, although getting it directly or indirectly from Monterey, thought it only a finer variety of the banded snails of their own vicinities, and thus gave it as a generally diffused species.

H. fidelis var. *infumata*. Mr. Binney does not refer to the evidences given by me for making this a variety, nor to its ranging 36 miles south of San Pablo Bay.

H. sequoicola Cp. This local race has characters connecting *fidelis*, *mormonum* and *dupetithouarsi* in about the degrees by which it is distant from their ranges. Mr. Binney's description, from a somewhat faded specimen, differs some from that of the types. Only the young shell is bristly up to five whorls, thus longer than in *traskii* and *mormonum*. His figure of *traskii* is from a small, probably stunted variety, as it grows a third larger. That of *diabloensis* is also from an immature specimen, if not a typical *ramentosa*. The colors of the animal of *mormonum* are described by him as different from that seen by me, but as the shells differ much in color, the animals may also in various localities of its long range. (See Proc. Cal. Acad. Sciences, VI, 1875, 18.)

H. rufocincta Newc. I spent several weeks on Santa Barbara Island, and examined it carefully for helices, finding thousands of some species, but none of this, so that I think the large race mentioned by Binney must have been from Catalina Island, where alone I found it, varying much in size. I was wrong also in referring the San Diego shell to this, as it has since been generally considered *carpenteri*. I have before stated the close resem-

blance in everything but small size of *H. gabbi* to this species, which it seems closer to than to *H. facta* with which Binney unites it.

As confirming the near relation of this group to *Campylæa*, it is notable that Mr. Binney mentions "*Campylæa*" *lapicida* (p. 379), which is so similar to our angled species. If not the type of Helix, the name *Helicigona* Risso, 1826, is, however prior, if the MSS. name, *Chilotrema* Leach, is rejected.

MESODON Raf.

M. townsendianus Lea. The internal characters of the animal certainly connect this species more nearly with *Mesodon* than *Arionta*, and the shell confirms this connection. Its more developed and reflexed lip, with the lower lip furnished with a "careniform tooth" is typical, while a little resemblance in sculpture is all it shows in common with *Arionta*.

M. (*Odotropis*) *devius* Gould. In that interesting locality, Shasta, California, Dr. Yates also found a dwarf variety of this species only about $\frac{4}{10}$ of an inch wide, and with only five whorls, evidently the Southern stunted race of this Northern species, nearly like Rocky Mountain specimens. Mr. Binney is certainly wrong in calling the bristly and three-toothed *Triod. mullani*, a variety of this species, though examples with faint teeth may look much like dwarfed *devius*. He unites them on p. 338, but on p. 432 shows that the jaws and teeth differ very much. On the same grounds I might call the Shasta specimens *loricata* as they approach it in size and form, or we might make half the Eastern *Triodopses* varieties of *Mesodons*.

"*Triodopsis*" *harfordiana* Binney, not Cooper, p. 309. The shell here described and figured is certainly not my shell, but seems a variety of *T. mullani*, the differences described in jaw and linguals not being so great as in *mullani* and *devius*. My shell differs in the flat spire, unreflexed lip, wider umbilicus, and 6 (not 4) whorls. In his arrangement it would be a *Polygyra* near *P. triodontoides*, and is very unlikely to range in the direction of Idaho.

Mesodon (*Aplodon*) *columbianus* Lea. I am satisfied that the examination of a few more animals of the toothed and imperforate form found in California, which so much resembles a large *germanus*, would prove to Mr. Binney's satisfaction that there is a regular gradation in the number of ribs on the jaws from 8 to 11, as stated recently by myself. Whether the genitalia constantly differ as described in Oregon specimens, requires further comparisons of fresh as well as alcoholic examples.

The list on p. 18, would suggest that both these species extend to San Diego, though really not found as yet south of lat. 36°, if so far.

GLYPTOSTOMA Binney and Bland.

The form of jaws alone is allowed to locate this near *Helix*, though most of its characters seem to indicate a nearer affinity to *Patula*.

PATULA Held.*

Mr. Binney now unites *P. cooperi* with *P. strigosa*, but on the same grounds should make all the species of the Central Province varieties of

* The great differences in jaws of "*Patulæ*" show that this organ must be considered inferior to external form, &c., in classification.

solitaria. The evidence from intermediate forms, is like that in the case of the *Arionta*, and yet the intermediate specimens are scarcely numerous enough to determine them as mere varieties, while he finds the teeth differ considerably. The fact that *solitaria* occurs as far west as near Vancouver, W. T., and near the localities of *strigosa*, at the Dalles (which is within the Central Province), without mixing, tends to prove distinctness of species in some degree. Future investigation of climatic peculiarities may determine the cause of some local variations.

The *Patula* from Alaska *referred* by me to *P. ruderata* with *a* (?), in the Amer. Jour. of Conch., V, 202, was certainly not *P. pauper* Gould as I at the time stated, and the diagnosis I gave then would distinguish them perfectly, yet Mr. Binney assumes that the Asiatic species is the same; though differences exist between them nearly as great as between *P. idahoensis* and *P. alternata!*

MACROCYCLIS Beck.

It is not yet determined that the Chilian type of this genus (*M. laxata*) is congeneric with our species, which may yet prove to require the name *Mesomphix* Raf (type *concava* according to Ferussac).

On p. 90, Mr. Binney followed my former statement that *M.? vancouverensis* did not extend S. of lat. 37°, though in Amer. Nat., Jan. 1873, I stated that I found it common near San Diego, and I have seen specimens from Central America, exactly similar (*vellicata* Forbes?).

ZONITES Gray, not Montfort. The original type of this genus, *algira*, appears to be very distinct from the thin diaphanous species, belonging to *Hyalina* Fer, though *Omphalina* Raf. (type *cuprea-fuliginosus* Griff., MSS.), may possibly have precedence.

Mr. Binney gives "*Z. nitidus*" as found at Astoria, Oregon (p. 114), and "*Z. cellarius*" as from Astoria, N. Y. If no confusion of localities has occurred, the former is just as likely to have been introduced on ships, as the latter, and not to be really circumpolar.

There appears to be an error, either in the dimensions given or the scale showing size of "*Z. stearnsii*," p. 128. Other probable errors of this kind occur in the book, among them a repetition on p. 360 of 31 millimetres for 21, the actual breadth of the type fig. of *A. redimita*. The want of a uniform scale of enlargement of minute species, is to be regretted.

ARIOLIMAX Mörch.

The figures given from alcoholic specimens have almost no value in comparing the outlines of the species, as they vary much, according to the degree of contraction of the animal, either when dropped in, or afterwards on account of the variable strength of the spirits used to preserve them. This variability also affects the form of internal organs, though in less degree, but probably enough to account for some of the differences described in viscera, though not those in jaws and linguals.

The figures given of *A. hemphilli* and *A. andersoni* show only such differences as can be found in a number of any one species put in alcohol

under varying conditions, and are thus undistinguishable from examples of *A. niger*. Of the value of the differences in jaws and teeth, it will require comparison of many from various localities to decide.

The species however, is *A. andersoni* W.G.B. not *Prophysaon andersoni* J. G. Cooper, sp.

Living specimens of these forms differ from *A. niger* only in pale colors, but all the slugs vary so much in this that it is an unreliable character.

Prophysaon W. G. Binney.

The figure given of *P. hemphilli*, represents exactly the alcoholic appearance of my *Arion? andersoni* (p. 236), and the description is conformable, allowing for difference in this respect. Still the internal differences observed, may distinguish the northern form until fully compared with the southern.

In my MSS. description, I remarked on the differences from *Arion*, and suggested the name *Limacarion*, which some friend suppressed in printing, probably thinking it preoccupied. I still have specimens so labelled at the time of writing. At any rate *Prophysaon andersoni* has priority, as a specific name over *P. hemphilli*.

On p. 239, Mr. Binney refers to the *fresh* specimens sent by me to him, but tries to find a discrepancy in my statement that it has a caudal mucous pore. I still think that it has one, but so small as to be imperceptible when contracted by alcohol. This "mucous pore" continues to be a great stumbling block in classification, although it only differs in degree of development in various genera. All of them are covered with mucous glands as in *Limax*, each gland with a pore opening externally, and the caudal gland merely varies in size. No more mucus is produced by *Ariolimax* than by a *Prophysaon* or *Limax* of the same size. The large cavity under the mantle as figured by Binney, is rather a notch between it and the end of the foot, than the opening of an enormous gland. In describing *Arion foliolatus*, Dr. Gould calls it a *pit* which tends to prove that form to be an *Ariolimax*.

Besides this character the position of the spiracle in my figure of *A.? andersoni* was sufficient to prove to Mr. Binney that it was not an *Ariolimax*, so that there was no need of making confusion by applying the name of my species to one of that genus.

The number of ribs on the jaw seems variable with age, and as I described the largest specimens, I found more than given by Binney in any of them. In some cases also, two or more ribs appear consolidated into a wide one, and the lateral ribs are rudimentary.

In quoting my locality of Santa Barbara for *A. columbianus* Mr. Binney does not consider that I afterwards separated *A. californicus* from that species, and that the extreme southern specimens are most likely to be the latter, if not a new form.

Surface Geology of South-west Pennsylvania and adjacent portions of West Virginia and Maryland. By John J. Stevenson, Professor of Geology in the University of the City of New York.

(*Read before the American Philosophical Society, August* 15, 1879.)

INTRODUCTION.

I. *Benches along Cheat River and vicinity—Along the Monongahela River—George's Creek—Redstone Creek—Along the National Road—Chestnut Ridge—Youghiogheny River—Westmoreland County, west from Chestnut Ridge—Ligonier Valley—Somerset County—East from the Alleghanies.*

II. *Resumé of the Facts—The Horizontal Benches—The River Terraces—Conclusions.*

The region in which the observations recorded in this paper were made, embraces of Pennsylvania the counties of Fayette, Westmoreland, Washington and Greene, with parts of Alleghany, Beaver and Somerset; of West Virginia, parts of Monongalia, Preston, Mineral and Hardy; and of Maryland, the extreme western portion. But the observations were made chiefly in the four counties of Pennsylvania first named and in Monongalia county of West Virginia.

The Alleghany Mountains of Pennsylvania form the eastern boundary of Somerset county. West from these in the same county are Negro Mountain and the Viaduct Axis, which unite with the Alleghanies near the northern line of Maryland to form Prof. W. B. Rogers' Tygart's Valley anticlinal in West Virginia. This great anticlinal is divided by Tygart's Valley into two monoclinal ridges, known as Cheat Mountain and Rich Mountain.

Laurel Ridge, the next west from Negro Mountain in Pennsylvania, is a bold mountain separating Westmoreland and Fayette counties from Cambria and Somerset; it extends into West Virginia and dies out before reaching the Great Kanawha river. Chestnut Ridge passes through Westmoreland and Fayette counties at twelve or fifteen miles further west, and is separated from Laurel Ridge by the Ligonier Valley, a canoe-shaped synclinal, which disappears southward not far beyond the southern line of Pennsylvania. Chestnut Ridge becomes insignificant soon after entering West Virginia, but in Pennsylvania it is almost as imposing as Laurel Ridge or the Alleghanies. West from Chestnut Ridge, only the Saltsburg anticlinal is strong enough to affect the topography. It forms Brush Ridge in Westmoreland and Fayette counties, but disappears very near the line of West Virginia.

The drainage west from the Alleghanies belongs to the Ohio river system and the smaller streams are tributary to the Conemaugh, the Youghiogheny, the Cheat, or the Monongahela. The first of these large streams flows into the Alleghany, while the second and third are tributaries to the Monongahela, which unites with the Alleghany at Pittsburgh to form the Ohio.

The Alleghanies of Virginia are reached in Maryland. They are not the same with those of Pennsylvania, but belong to the series of anticlinals next east. In this region, the Potomac river, rising near the Alleghanies of Pennsylvania, breaks through the Alleghanies of Virginia and flows past Cumberland on its way to the Atlantic Ocean.

Within the whole area examined, no traces of glacial drift occur, except along the banks of the Ohio river, where such material appears on the terraces, having been brought down by the Beaver and Alleghany rivers from the northern counties.

Some notes respecting the river terraces of the Ohio and Monongahela rivers were given in my report on the Greene and Washington district of Pennsylvania (1875). The observations begun in 1875 were continued during 1876 and 1877, and the surface geology was studied as closely as was possible without interfering with the economic investigations, which were the main object of the survey. Some of the observations are recorded in my report on the Ligonier Valley of Fayette and Westmoreland counties (1877). Barometric measurements were made wherever a terrace or bench could be recognized, but, in very many cases, these observations proved to be worthless as no spirit-leveled line was within reach to be used as a base. The measurements given in this paper were verified by direct reference to leveled lines and by repetitions.

I.

Benches along Cheat River and its Vicinity.

Cheat and Monongahela rivers unite in Pennsylvania at about two miles north from the line of West Virginia. Their channel-ways diverge rapidly, so that the former stream issues from Chestnut ridge at little more than three or four miles south from the State line, while the latter breaks through the same ridge at fully thirty miles further south. The course of Cheat is rudely north-west, and that of the Monongahela rudely north and south.

Stewartstown Benches. In the peninsula between these rivers and west from Chestnut Ridge, a line of high knobs begins at about a mile west of south from the mouth of Cheat and continues in an irregularly south direction to Dorsey's knob beyond Morgantown in West Virginia. These hills are nearly alike in height and reach to about 600 feet above the rivers at their junction. They are rudely conical and their sides are terraced. On one of these hills is the village of Stewartstown, at nearly three miles from Cheat river. In descending from this place to either river, the following series of benches was seen :

Tenth	Bench.....	525	ft.	above river,	1295	ft.	above tide.
Ninth	"	465	"	"	1235	"	"
Eighth	"	425	"	"	1195	"	"
Seventh	"	360	"	"	1130	"	"
Sixth	"	330	"	"	1100	"	"
Fifth	"	280	"	"	1050	"	"
Fourth	"	210	"	"	980	"	"
Third	"	180	"	"	950	"	"
Second	"	80	"	"	850	"	"
First	"	20	"	"	790	"	"

Ice's Ferry. Descending from the State line to Ice's ferry, on Cheat river, at nearly nine miles above its mouth, one sees the first, second, third, sixth, seventh and eighth benches of the series just given, but the fourth and fifth have been so disguised by erosion that they cannot be recognized. Above the third, there are no transported fragments, and the higher benches to the sixth are covered by an irregular deposit of sand with more or less clay. But no clay was observed on the eighth bench. Ascending the opposite side of the river and following the road toward Morgantown, one finds rolled and polished stones, mostly of small size, occurring in great numbers up to the level of the third bench, where they suddenly disappear. The ninth bench is reached on this road at about three miles from the river near the church and school house. The mile-ground, a level stretch about a mile long and nearly the same distance from Morgantown, is on the eighth bench.

Standing here and casting the glass around the horizon, one finds this bench marked by flat-topped hills far beyond Decker's creek, which enters the Monongahela at Morgantown, while the same bench is distinctly continuous along the face of Chestnut Ridge southward to certainly beyond the gorge of Booth's creek, which enters the Monongahela river at somewhat more than 12 miles south from the State line. As ascertained from the records of wells bored or digged on the mile-ground, the deposit consists of coarse sand, sometimes containing a little blue clay, in all from 4 to 22 feet thick.

The seventh bench of the Stewartstown series is reached further along the road, where the valley of Decker's creek is first reached, and it is continuous thence around the hills to the Monongahela side. The third bench is well marked at Morgantown and, opposite that village, decayed shells of *unio* have been ploughed up at that level.

Line Ferry. Here, at three miles from the mouth of the river, the seventh, eighth and ninth benches of the Stewartstown series are distinct on the West Virginia side, but the lower ones have been removed or they have been disguised by erosion so as to be unrecognizable.

In descending from the north towards this ferry, one has difficulty in recognizing any of the benches, as the hill is abrupt and covered with forest; but rolled stones appear suddenly and in great numbers at 210 feet above the river bed, and increase thence in size as well as in number to the surface of the stream; while on the opposite side, transported fragments are numerous up to the level of the fifth bench. On both sides the higher benches are covered with sand, showing no polished fragments, but containing many small pieces of rock belonging to the immediate vicinity, which have been little affected by weathering and evidently have not been subjected to the action of running water.

Benches along the Monongahela River.

Between the State Line and George's Creek. Coming from the south to Point Marion, where the Cheat and Monongahela rivers unite, one finds all the Stewartstown benches distinct except the third, which has been de-

stroyed by erosion on the east side of the Monongahela, though it is still shown on the west side. The higher benches are almost equally distinct on both sides of the river. Polished fragments occur in great numbers up to the line of the fourth bench and, even at that elevation, many of them are of enormous size.

Crossing the Ferry at Point Marion and taking the hill-road to New Geneva, at the mouth of George's creek, one reaches the third bench at half a mile from the river. It is covered by coarse sand mingled with clay, which has boulders freely distributed throughout its whole mass. Such fragments are numerous up to 280 feet from the water's edge, the line of the fifth bench. The eighth bench is reached at somewhat more than a mile from Cheat river, and at the first cross-road it bears a deposit of sand whose thickness has not been determined. A flat-topped hill near this place marks the level of the ninth bench.

The fifth bench is of interest here. It is reached on this road very soon beyond the divide separating George's creek from Cheat river. There it bears a valuable fire clay with pockets of excellent glass sand. The irregularity of the deposit is shown by sections obtained in two neighboring pits. The one shows:

1.	Sand, clay, etc	11 feet.
2.	Sand, white, very clean	3 "
3.	Clay, ferruginous, sandy	1 foot.
4.	Clay, black, very good	1 "
5.	Clay, white, good, but containing ferruginous streaks	7 feet.
6.	Clay, ferruginous, seen	10 "
	Total	33 feet.

The other section is:

1.	Sand, clay, etc	8 to 10 feet.
2.	Clay	3 to 10 "
3.	Ferruginous conglomerate	0 ft. 1 inch.
4.	Glass sand	6 feet.
5.	Sand, inferior	unknown.

Respecting the thickness of the ferruginous clay, No. 6 of the first section, nothing is known further than that at 10 feet from the top the tools used in boring became hopelessly fast. An attempt was made to bore through the sand, No. 5, of the second section, but the tools could not be pushed beyond 15 feet.

At a little distance beyond the pits, the third bench of the Stewartstown series is reached, but the fourth bench has been masked by erosion so that the wash from the thick deposit on the fifth covers the place of the fourth and becomes continuous with the deposit on the third. Throughout the deposits on both benches, transported fragments are found in vast numbers. A well digged on the third bench is 23 feet deep and does not reach the bottom of the sandy deposit. At a little way beyond, the bottom of the sand is reached and the thickness to the rocky shelf is shown to be 35 feet.

The black clay of the first section, commonly known as the "swamp clay," was reached in a boring here at 25 feet from the surface. In it, amid the numerous fragments of half-rotted wood, the cupule of an acorn was found along with what seemed to be berries of the black haw. The latter were thoroughly carbonized and crumbled rapidly on drying; but the acorn cup was still tough, and it was kept for some time as a curiosity. The wood in this clay is tough enough to snap in breaking and it has the peculiar tint characterizing the half-rotted wood so frequently seen in peat bogs.

A point of the third bench projects towards George's creek at a little north from the road. *Unio* shells, much decayed, are common here and are barely covered by the soil.

A rise in the road at half a mile nearer to New Geneva brings it again to the level of the fifth bench. There a small deposit of glass-sand was found, but it was soon worked out. It rested on an irregular deposit of clay and sand.

This fifth bench is continuous along the river hills from the State line to the mouth of George's creek, except where cut away by streams, but sometimes it is so defaced by erosion as to be recognized only with difficulty. It is handsomely preserved at Greensboro', on the west side of the river opposite New Geneva, where it shows vast numbers of rolled stones. Mingled clay and sand occur above it to 300 feet above water-level.

Between George's Creek and Redstone Creek. Below Greensboro' on the river hill, benches occur at 20, 180, 265 and 310 feet above low water. At the mouth of Whitely creek, in Greene county, the third bench of the Stewartstown series, at 180 feet, is very distinct up the creek to the village of Mapletown, and polished fragments are numerous all the way. At the mouth of Muddy creek, in the same county, the fifth bench, covered with rolled and polished stones, is handsomely shown, and along the creek it is quite perfect as far as Carmichaels, where the detrital coating is as thick as it is along the river.

On Pumpkin run, in the same county, this bench is shown with the same features. The measurement given in the Greene and Washington report* is erroneous and the bench is confounded there with one which was not seen in the Stewartstown series, but which seems to be intermediate between the fifth and the sixth, and to be persistent along several of the streams in Greene county at 30 feet above the fifth bench. At the mouth of Ten-mile creek the first, third and fifth of the Stewartstown series are shown, together with the supplemental one just mentioned; while at Frederick, in Washington county, or rather, at two miles back from the river, and near Frederick, is a still higher one, which is clearly the same with the eighth of the Stewartstown series, though the erroneous measurement given in the Greene and Washington county report would make it intermediate between that and the seventh.

* During part of the season of 1875 I used a barometer which proved to be quite bad. In this way came the erroneous measurements referred to.

Between Redstone Creek and Pittsburgh. The benches are handsomely shown on both sides of the river below the mouth of Redstone creek, which enters the river at Brownsville, 50 miles above Pittsburgh. At Belvernon, near the northern line of Fayette county, the deposit on the third bench has been opened to procure glass-sand; and at present two excavations are worked on the opposite side of the river. At the upper one of these the following detailed section was obtained:

1. Alternations of fireclay, gravel and coarse sand, with fragments of varying size; the whole containing much carbonaceous matter in streaks, mostly broken coal; very ferruginous toward the base ..... 12 to 16 ft.
2. Sand, fine and angular, excellent for manufacture of fine window and mirror glass; containing thin, irregular layers of blue plastic clay, with occasional layers of conglomerate cemented by oxide of iron; contains also numerous rounded fragments of rock, some of them very large; the pebbles are of limestone, sandstone, and carboniferous conglomerate.... 16 to 22 ft.
3. Coarse sand and gravel, with many small rounded fragments; much carbonaceous matter, coal, and imperfect lignite; occasionally yields large fragments of trees. This is often a ferruginous conglomerate ..... 2 ft.
4. Ferruginous sand, frequently conglomerate; contains some transported fragments of considerable size ..... 2 to 4 ft.
5. Blue plastic clay ..... 0 to 4 ft.
6. Blue laminated shale of the lower barren series.

The plastic clay, No. 5, is evidently derived from the underlying shale on which the deposit rests. The section shown in the other excavation is:

1. Clay, containing rounded fragments, lumps of coal, etc..... 10 ft.
2. Dark sand used for moulding..... 7 ft.
3. White sand, used in making glass..... 7 ft.
4. Sandy and clayey material, containing rounded fragments and lumps of iron ore..... 1 ft.
5. Dark sand ..... 4 ft.

As these excavations are barely half a mile apart, they show the extreme irregularity of the deposit, which is from 40 to 45 feet thick at the upper excavation, while at the lower one it rarely exceeds 35 feet.

At Monongahela city, the third and fifth of the Stewartstown benches are at 190 and 320 feet above low water mark; above these are the sixth and eighth at 1110 and 1190 feet above tide. Between the third and fifth there is an ill-defined bench at 290 feet above low water, which is distinct further down the stream, for a terrace, holding that place, is reported from Peter's creek and Thompson's run. The third bench, also, is well defined down the river, being that along which the Pennsylvania Railroad runs from just below Braddocksfield almost to Pittsburgh.

The lowest bench at Monongahela city is at 40 feet above the river or at 750 feet above tide. The Baltimore and Ohio Railroad runs along this

bench for a considerable part of the way below the mouth of the Youghiogheny river. It is the bench along the river front at Pittsburgh.

Benches along George's Creek. The third and fifth benches of the Stewartstown series are persistent along this creek, but constantly rise up-stream so that at the village of Smithfield the fifth is 304 and the third 200 feet above the river at the mouth of the creek. The rise is quite regular and in this distance the lower one has gained five feet on the upper one.

The eighth bench is shown on the south side of the creek near the village of Morris Cross-roads, forming the crests of several flat-topped hills on the divide between George's creek and Grassy run, the latter a tributary to Cheat river. Its absolute level is unchanged, being 1195 feet above mean tide. The sixth bench is found near Grassy run, and the second is there at 80 feet above the run, or 125 feet above Cheat river at its mouth.

Crossing the divide between Grassy run and Rubbler's run, also tributary to Cheat river, several benches were seen, but their relations could not be made out owing to lack of time. On Mitchell's hill, projecting from Chestnut Ridge almost immediately behind the old Springhill furnace, the eighth bench stands out from the mountain for almost 400 yards. This bench is continuous thence southward to the line of West Virginia, where, as the divide between Rubbler's run and Cheat river, it extends for a long distance eastward and westward. Its elevation was determined on this divide and differs from that near Stewartstown by barely five feet.

Returning to George's creek and taking the road from Smithfield to Uniontown, which follows the west side of the valley, one finds the third, fifth and sixth benches constantly persistent along the side of Brush ridge, which, as already mentioned, is the elevated land marking the course of the Saltsburg anticlinal. East from the road are some minor benches whose relations were not made out.

Beyond the creek, on the flank of the mountain, fragments of the eighth bench are occasionally shown, and the same bench is reached on the road at the summit of the divide between George's and Redstone creeks at one mile from Uniontown.

Meanwhile, in ascending the creek, the fifth bench has shown a constant increase in altitude, so that as the divide is approached, that bench takes place of the sixth and finally is merged into the seventh. According to the barometer, the eighth bench is somewhat higher here than at the mouth of Cheat river, being 1206 feet instead of 1195, but the measurement was not verified. No opportunity was afforded for following out the minor benches in this valley, but their steady rise from the river to the village of Smithfield justifies the belief that they rise with the stream until, at last, the "bottom" becomes merged into the highest bench at the head of the stream.

Benches on Redstone Creek. No little difficulty was experienced in the attempt to trace out the benches along Redstone creek, which enters the Monongahela at Brownsville, 50 miles above Pittsburgh. From the river to Upper Middletown, 3 miles below Uniontown, the creek is hemmed in

by high hills and the valley is so narrow in many places that the benches are necessarily very indistinct. It is sufficiently clear, however, that the bench, on which Uniontown is built, is the same with the third of the Stewartstown series as exposed at Brownsville. The transported fragments were seen on Redstone at five or six miles from the river, where the bench is fairly well defined. Further up, the same bench is imperfectly shown at Upper Middletown.

Along the road leading from Uniontown to Connellsville, the eighth bench is reached very soon after leaving the National road, and it is exposed again near Lemont furnace at four miles from Uniontown, where the sixth bench is handsomely preserved at 90 feet below it. The latter bench shows changes in level as insignificant as those of the former.

The eighth bench is persistent throughout the whole of the Redstone valley east from Brush Ridge, but it becomes a little obscure near the summit dividing the waters of Redstone from those of Dunbar creek. There a higher bench was seen, which belongs between the ninth and tenth of the Stewartstown column.

On the old Pittsburgh road leading north from Uniontown, the eighth bench is well shown, and, at the first summit, the tenth bench is reached. This seems to be the most extensive plain along the east side of Brush Ridge.

Benches along the National Road.

Between Uniontown and the Monongahela River. The National road between Uniontown in Fayette county and Washington in Washington county seems to have been laid out with the view of crossing the summit of every high hill between the two boroughs. It affords excellent opportunity for the study of the higher benches with the least possible expenditure of labor.

The eighth bench is soon reached west from Uniontown, and a persistent floor representing the seventh bench is shown at 50 feet below it. The tenth bench is seen at three miles west from Uniontown; and a rude survey of the surrounding country, made with the level, shows that bench to be very widely persistent and to be the important plain of Brush Ridge.

The ninth bench is reached on the hill holding the eastern outcrop of the *Pittsburgh coal bed* at five miles west from Uniontown. At that place one comes to the benches of Dunlop's creek, and the ninth bench is seen to be constantly distinct along that stream during its passage through the arch of the Saltsburg axis.

On the hill beyond the old hotel at nearly nine miles west from Uniontown, a higher bench is reached, which is shown in several hills in the vicinity, all of them flat-topped. These truncated cones mark an eleventh bench, whose altitude is 60 feet greater than that of the tenth, or 1350 feet above mean tide.

The tenth bench is reached again at a little way further west, and thence for a considerable distance the road runs on the ninth which is handsomely defined.

Thence to within a mile of Brownsville, the country is so disfigured by erosion that nothing can be determined ; but at that distance from Brownsville one comes within sight of the Monongahela river and the road soon falls to the eighth bench, which has an absolute altitude of 1185 feet, if the engineers' station at West Brownsville was correctly identified. This is ten feet less than at the mouth of Cheat river and 5 feet less than on the Connellsville road near Uniontown. The other benches below this are sufficiently distinct along the river above Brownsville.

Between the Monongahela River and Washington. On the west side of the river, the eighth bench is reached within a mile and it is the important one north and south as far as the eye can reach, until one comes to a station, known as Kreppsville, say three miles west from the river as measured along the road. But there, at a short distance north from the road, a higher bench is seen at 1225 feet, which seems to be the ninth of the series and is persistent northward. The road reaches this bench at a little way further west and follows it to near the village of Centreville, where, while crossing a stream, it comes down to the eighth bench. At Centreville, it returns to the ninth, while both north and south from the village a higher bench is seen in fragments, with an elevation of 1245 feet. Still further north, the tenth bench is shown in the crowns of several flat-topped hills, which have an elevation of 1285 feet.

Between Centreville and a mile and a half east from the village of Beallsville, the road runs alternately on the 1225 and the 1245 feet bench, but at the latter place it falls to the eighth as it crosses the valley of a stream emptying into the Monongahela river. It quickly rises again to 1225 and then to 1245 feet, both distinct benches, and within a short distance it comes up to the tenth. The last is the great bench north and south, and apparently it is the most important bench thus far on this side of the river.

West from Beallsville is a high hill, which seems to mark the dividing line between the benches of the Monongahela Valley and those belonging to the valley of Chartiers creek and the Ohio river at the west, though it is broken by Pike run at a little way north from the National road. On this hill, one rises to 1420 and 1445 feet above tide, two splendid benches, and the summit of the hill is little less than 1500 feet.

Descending the west side of this hill, one comes to the 1420 feet bench and goes below it ; but in ascending the first summit east from Hillsborough, he crosses benches at 1420, 1445 and 1475 feet, all of them perfectly distinct, the first two quite as much so as on the east side of the Beallsville Ridge. Descending from this, one soon comes to the tenth bench at 1295 feet, but in ascending to Hillsborough he again crosses benches at 1420, 1445 and 1475 feet and reaches 1505 feet at the hill-top, the three benches being very distinct. Hillsborough is at 12 miles east from Washington.

At eleven miles east from Washington, the road crosses the 1445 feet bench ; at ten miles, the bench at 1380 feet ; and at 9½ miles, the tenth at 1295 feet. At nine miles, one reaches the head of Pike run, and in the

whole region north from the National road, the tenth bench is the most widespread, the one which gives character to the country. At 8 miles and a half from Washington, the general elevation of the country increases and the road rises, so that from that point to the four-mile post the road oscillates between the 1420 and the 1445 feet bench. But near that post it falls to 1375 or 1380 feet and comes upon a fine terrace, which is of considerable extent north and south from the pike.

Between the second and third mile-posts, the road crosses an island of the 1420 feet bench and at the second post it is again at 1375 feet. This is the principal bench of the Chartiers Valley, being well shown on both sides. The lower benches came out in their order from this horizon down to the railroad depot at Washington, which is near the place of the sixth bench.

The observations from the river to Washington were made altogether with the barometer, but under very favorable circumstances, for on repetition the measurements showed insignificant variations; and in both cases the total change in the barometer during the passage was barely five one-thousandths of an inch; the altitudes of the stations terminating the line having been well determined by railroad levels.

Benches on West Side of Chestnut Ridge South from the Youghiogheny River.

This slope shows for the most part a very regular face in the Redstone region. Near the West Virginia line and beyond that southward as far as the observations were carried, the rocks of the Lower Barren and Lower Productive Coal Series have so far escaped erosion, that the benches below the eighth are easily recognized. Northward from the middle of George's township, in Fayette county, to the divide between Redstone and Dunbar creeks, the lower rocks of the Coal Measures have been in great part removed, and the massive Pottsville (Seral) conglomerate, resisting erosion, has remained to give the mountain its present slope. The benches do not exist where this rock forms the face of the ridge and traces of them are very rare. It is noteworthy that the outcrop of this conglomerate, though at a considerable distance from the plane of the axis, is not much below the average elevation of the summit of the ridge.

On the summit, at the National road, the surface is covered by a fine reddish sand, almost free from clay, which is well shown at the Summit hotel. The well on the opposite side of the road was digged in this sand to the depth of 40 feet, and the people in the vicinity were surprised by the occurrence of river snails and mussels, many of them being quite fresh looking. This point is about 2400 feet above tide. A well marked bench was seen on the Seaton road, 180 feet higher, which extends along that road for nearly two miles south from the National road and is covered with loose sand derived from the disintegration of the Pocono (Vespertine) sandstone. A level bench covered by loose sand can be followed for several miles along the crest of this ridge.

Some of the low gaps, which extend to but a short distance below the summit are beautifully terraced. The benches in Wymp's gap, exposed by removal of the timber, are distinct to one standing even on the opposite side of George's Creek Valley. The gorges made by the larger streams are usually so narrow and have so abrupt walls that no benches remain, and it is doubtful if benches could have existed in any but very few of them. For this reason no benches below the eighth have been fully recognized along the greater part of this face, south from the Youghiogheny river.

Benches along the Youghiogheny River.

The river "bottom" at M'Keesport is at 765 feet above tide. Thence it is continuous to Connellsville, at the mouth of the Chestnut Ridge gap, where it is 894 feet above tide.

At Perryopolis, just south from the river, a fine bench is shown covered by sand, which contains many enormous bowlders, all of which have been brought down from the mountain gaps.

Possum run enters the river almost opposite Connellsville. On the road leading along this run from that borough to Brownsville, a bench, reached at the first summit, barely 200 feet above the river, is the highest limit of transported fragments. All of the bowlders are of huge size and many of them weigh not less than a ton. They have polished surfaces and are so numerous that the farmers use them in building fences. This bench is the same with that seen at Perryopolis.

This bench is persistent along the river above Connellsville, but it can be followed only with difficulty as slides in the gaps have masked it at several localities. It is very nearly 200 feet above the river at Connellsville, but thence it rises less rapidly than the river bed, so that at Ohiopyle Falls it is not quite 140 feet above the stream. While flowing on this bench as its bed, the river ran directly across the neck of the peninsula at Ohiopyle Falls, and the gorge through which the stream now flows has been eroded since the bed fell below that bench.

At Confluence, immediately above the east end of the gap through Laurel Ridge, the river "bottom," which is only 765 feet at M'Keesport, is 1346 feet above tide or 581 feet higher than the same bench at the mouth of the river. A very fine bench was seen southwest from Confluence at 1820 feet above tide. The persistent bench to which reference has been made, is still seen along the river, but is much nearer the stream than it is at Ohiopyle. Riding up Castleman's river, which unites here with the Youghiogheny, one soon rises above this bench or rather finds the river bottom merged into it.

Benches in Westmoreland County West from Chestnut Ridge.

Few available measurements were obtained in this part of Westmoreland county. The survey was made during the autumn of 1876, a season strangely marked by violent fluctuations of the barometer; but no measurements have been accepted as trustworthy except such as were verified by direct comparison with a spirit-leveled line as a base.

Though the observations thus available are very few, yet they suffice to show that the system of benches in this county is the same with that found in Fayette and Washington.

The eighth bench of the Stewartstown series is shown half a mile west from Jacksonville, near the county line on the Pittsburgh and Bedford road, at 1190 feet above tide; a still higher one at Jacksonville with an elevation of 1230 feet, is evidently the ninth of that series. These benches are well shown both north and south from the pike, forming the crowns of many hills, while the tenth is distinct north from the Pennsylvania Railroad. Following the pike one finds the twelfth bench at three miles and a half west from Greensburg, with an elevation of 1380 feet, precisely the same as on the National road many miles southwest; and at two miles west from Greensburg the ninth (?) is shown with an elevation of 1242 feet. Benches were seen north from Greensburg at 1185, 1270, and 1300 feet on the road to New Salem, evidently representing the eight and tenth with the intermediate bench seen in Fayette county between the ninth and tenth.

The highest point at the village of New Salem is on the eleventh bench, which is of wide extent in that part of the country. The benches are finely shown west from New Salem along Turtle Creek and its tributaries, but unfortunately, all of the measurements made in that vicinity proved altogether worthless, owing to flagrant variations in the barometer.

Measurements made on the Bedford pike near Latrobe, as it descends to Loyalhanna creek, showed the fifth, sixth, eighth and ninth benches at 1050, 1105, 1185 and 1240 feet above tide. The fifth is here the "bottom" of the Loyalhanna. The highest plain seen near the pike is about 1450 feet above tide.

Benches in the Ligonier Valley.

On the National Road. There was no means of verifying the measurements made here. The base used is the altitude of Chestnut Ridge summit as determined by the original survey at 2400 feet above tide. This determination agrees closely with that shown by the barometer, the railroad level at Uniontown being taken as the base; but as gross errors were made by the engineers in running the line for the road, and as there is no well-fixed point nearer than Uniontown, the altitudes of the benches cannot be regarded as fairly determined. At the same time it may be best to record the levels obtained, because they show that the surface of Ligonier Valley is marked by horizontal benches precisely similar to those seen on the west side of Chestnut Ridge. The following series was made out between the summit and the village of Farmington, midway between Chestnut and Laurel Ridges: 2155, 2060, 1965, 1880 feet above tide. The crowns of the hills in this part of the valley are almost absolutely level and the escarpments of the benches are very steep. The forms stand out more fairly than they do west from Chestnut Ridge.

South from the National road, Laurel Ridge loses its mountain character

and, as it were, breaks down into a broad level country, known as the "Glades," which stretches over into West Virginia and Maryland. Though thus breaking down, the ridge loses little of its height, and the "Glades" are not far from 2200 feet above tide. In general character this plain is precisely like the benches.

A fine series of benches was seen near Indian creek at Springfield in Fayette county, but no way existed whereby the exact altitude could be determined, and no measurements were made.

Near the Loyalhanna. Between Ligonier and the village of Stahlstown in Westmoreland county, on the divide between Four-mile run and the Loyalhanna, the following benches were found: 1690, 1570, 1520, 1480, 1390 and 1245 feet above tide. These measurements were verified by reference to the levels of the Ligonier and Latrobe Railroad at Ligonier. The last three are remarkably near three seen on the National road not far from Hillsborough, and the last two undoubtedly represent the ninth (?) and twelfth of the series.

Benches in Somerset County.

The elevation of Meyersdale on the Pittsburgh and Connellsville Railroad has been well established at 2063 feet above tide. Within sight of that village are three fully defined benches at 2123, 2288 and 2323 feet above tide, as determined by barometer from Meyersdale.

The first bench is the floor of the country away from the Castleman's river; is shown on the hill between Elk Lick creek and the Castleman's; is the first bench on the road to Berlin north from the River, where it is beautifully distinct; and is again reached on the summit beyond the crossing of Blue Lick by that road. At each of these places the bench is seen to be persistent over a wide area.

The second bench is at the hill-top on the property of the Cumberland and Elk Lick coal company, and its place southward from that locality is shown by flat-topped hills. The same bench was seen on the road to Berlin.

The third bench was seen on the road to Berlin at the Pine Hill church as well as at Berlin, where its existence is proved by the flat-topped hills. All of the benches are distinct at Berlin, and the second and third are well preserved along the west face of the Alleghanies.

East from the Alleghanies.

The observations here are not in detail. For the most part they were taken hastily along Wills creek and in the vicinity of Cumberland. Enough, however, was ascertained to show that a series of benches similar to that already described, exists along the east side of the Alleghanies in Maryland.

Fine river terraces were seen along the Potomac and on Wills creek, which enters the Potomac river at Cumberland. The chief terrace of the Potomac is easily traced from Cumberland to Piedmont, and has even more rapid rise than along the Youghiogheny or the Castleman's river. The

detrital fragments become very coarse in the mountain region, just as they do on the Youghiogheny and Castleman's, and the deposit bears some resemblance to glacial debris. The huge fragments have been transported but a short distance, and slides from the mountains are mingled with detritus moved by the stream; so that, upon the whole, the deposit has little likeness to the material covering the terraces on the lower Monongahela or Youghiogheny, where the larger blocks have been rounded during their long journey, while many of the smaller ones have been reduced to fine sand or clay.

II.

Resume of the Facts and their Relations.

Looking now at the observations recorded in the foregoing part of this paper, we see that although very fragmentary, they show the existence of two sets of benches, in one of which, the higher, the individuals have an almost unvarying level, whereas in the other or lower set, the members have no definite altitude with respect to tide, but vary much, as do the beds of the streams along which they are found. Arranged in tabular form, we have, first the benches of the higher series:

1.	Chestnut Ridge, Seaton road.....	above tide,	2580 feet.
2.	Chestnut " National road.....	"	2400 "
3.	Top bench in Somerset county.....	"	2323 "
4.	Middle bench of "	"	2288 "
5.	Bottom " "	"	2123 "
6.	Bench near Confluence	"	1820 "
7.	Sixth bench near Loyalhanna.....	"	1690 "
8.	Fifth bench " "	"	1570 "
9.	Fourth " " "	"	1520 "
10.	Third " " " also at Hillsborough and Beallsville.....	"	1475 "
11.	National road, Washington county..	"	1445 "
12.	" " "	"	1420 "
13.	Second Loyalhanna bench, also National road near Beallsville and Hillsborough.....	"	1380 "
14.	National road east from Brownsville	"	1350 "
15.	Tenth bench of Stewartstown series,	"	1290 "
16.	Intermediate bench, Dunbar cr., Possum cr., Greensburg.....	"	1270 "
17.	Ninth bench of Stewartstown series First Loyalhanna bench...above tide,	1225 to	1240 "
18.	Eighth bench of Stewartstown series, above tide,		1195 "
19.	Seventh " " " "		1130 "
20.	Sixth " " " "		1100 "

The elevation of low water at Pittsburgh, as used by the City Surveyor's office, is 699 feet above mean tide.

Comparison of the levels given in this table with those given in the preceding notes shows some discrepancies. The altitudes used in the tables approach the means, or nearly so, of the measurements. At the same time, no bench, aside from No. 17, shows any material variation, and in that two are confounded. That two distinct benches belong here will be seen at once by examination of the notes on the National road and on Westmoreland county west from Chestnut Ridge. But it would be unwise to correct the error in this table, as the numbers there given have been published elsewhere,* and any change in the order might prove inconvenient.

The benches seen in the southern part of the Ligonier Valley are omitted, because their elevation cannot be regarded as satisfactorily determined.

The variations in level exhibited by individual benches of this series are so slight that they may be due either to petty variations of the barometer or to errors in reading it, or to the fact that, in every case, the highest point on the bench was sought, so as to determine the top of the detrital deposit. As that deposit, though very thin, has suffered more or less from erosion, one could not, even with perfect instruments, obtain a series of measurements which would tally accurately. The extreme of variation, even in No. 17 where two benches are confounded, is scarcely 18 feet; so that one is fairly justified in regarding the benches as practically horizontal and parallel.

The deposit on these benches sometimes contains a little clay, but sand greatly predominates. No rolled or polished fragments of stone occur; and such fragments as are present belong altogether to rocks found in the immediate vicinity. Nothing shows that running water had ever passed over these plains, so that if the water were in motion, its effects must have been confined within a limited space.

The benches of the lower series have no fixed level, but are precisely analogous to the bottoms of the streams which flow below them. In tabular form this series may be given as follows:

1. Fifth bench of Stewartstown series....above tide 1050 feet.
2. Fourth bench of same..... ..... " 980 "
3. Third bench of same..... " 950 "
4. Second bench of same..... " 850 "
5. First bench of same..... " 790 "

The elevations given in this list are those observed at the mouth of Cheat river, and are used only to show the intervals between the benches at a locality where the series is well exhibited.

It has been said that no absolute altitudes can be assigned to members of this series: the lowest bench is 790 feet above tide at the mouth of Cheat river, but at Pittsburgh it is only 765 feet; the third bench is 950 at the mouth of Cheat, but 920 at the mouth of Turtle creek in Allegheny county. More marked variations occur on George's creek, the Youghiogheny and many other streams.

* *American Journal of Science* for May, 1878; and Part II of Report on the Fayette and Westmoreland District of Pennsylvania (1877).

As mentioned in my first report on the geology of southwestern Pennsylvania (that for 1875), these lower benches are merely shelves cut out of the rock, on which are spread thin deposits of irregularly or even wholly unstratified débris. At some localities, the lower part shows little aside from clay, while the upper part is made up almost wholly of sand, but ordinarily one of these occurs in pots within the other.

Transported fragments, rounded or polished, appear with this series. Those in the Monongahela benches have been brought from the south and east, for no rocks are represented except such as occur in the mountains crossed by the Youghiogheny and Monongahela or their tributaries; and no material belonging to the northern drift was found anywhere south from the junction of the Ohio and Monongahela rivers. The detrital covering seems to be greatest on the third and fifth benches, where it is of no small economical importance, the third yielding the glass-sand of Belvernon, and the fifth, the glass-sand of Perryopolis and the fire-clay of New Geneva.

The upper limit of rolled stones shows some perplexing variations, which can be accounted for only by supposing that the higher benches of the series have been worn away from one side of the stream, or that, during the formation of two successive terraces, the channel-way held close to one side. On Cheat river, near Ice's ferry, at nine miles from the Monongahela, the upper limit on the south side is the third bench; near the Line ferry, further down on the same river, no fragments occur on the north side above the fourth, though they are numerous on the south side up to the fifth; the fourth terrace is the upper limit on the south side at Point Marion, whereas fragments are abundant up to the fifth on the north side. No fragments have been found anywhere above the fifth bench.

After passing the third bench, the Monongahela river seems to have suffered changes in its channel-way. Below Belvernon, there is distinct evidence that it now flows along a line very different from that followed when its bed was on the third bench. The change was more serious near Pittsburgh. The river had a direct course from Braddocksfield to the Allegheny and that line is now followed by the Pennsylvania Railroad. The present channel-way of the river is very tortuous. A similar change is shown at Ohiopyle Falls on the Youghiogheny, where the old channel on the fifth bench crossed the neck of a peninsula, while the new channel-way makes a long and close bend around the peninsula.

The conditions, then, are these: The area in which observations were made covers more than 10,000 square miles; embraces that part of Pennsylvania lying south from the Ohio and Conemaugh rivers and west from the Alleghanies; includes part of Maryland and West Virginia, lying on both sides of the Alleghanies of Virginia; and has the channel-ways of four great rivers, the Monongahela, Cheat, Youghiogheny and Potomac, lying partly within it. Along all these streams are terraces, covered by detritus, which contains many transported fragments polished by running water;

these terraces fall down stream, though not so rapidly as do the present stream beds.

But a second series of benches or terraces appears throughout this whole region and seems to be characteristic of a very much wider area than that in which observations were made. The members of this upper series differ in many respects from those of the lower series; their coating of débris contains little clay and no polished fragments; they are almost absolutely horizontal and parallel; they do not merge into the lower series, though as the higher benches often form divides between the streams, the lower or stream terraces always end up in one of them. These horizontal benches begin within the area west from the Alleghanies at 1100 feet above tide; they line the faces of the mountains, they curve round the conical hills and often they are indicated only by the leveled crowns of the higher knobs.

Let us look at these series separately, beginning with higher one.

The Horizontal Benches.

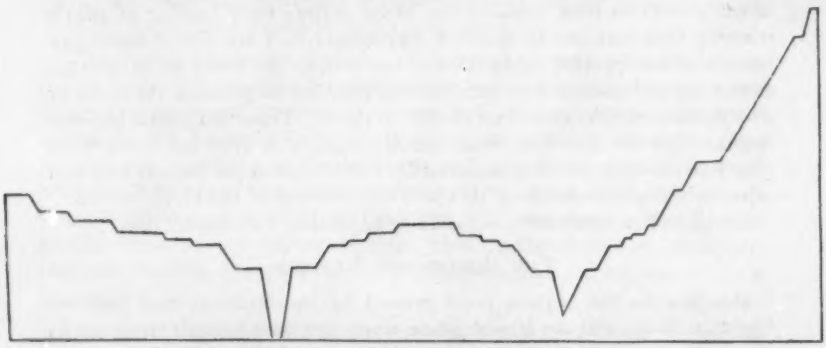
Standing on the highest point crossed by the National road between Chestnut Ridge and the Monongahela river, one finds himself on an island of bench 14, or 1350 feet above mean tide.* Below him an almost continuous plain of the fifteenth bench stretches for a long distance north and south and is broken only by gaps through which the larger streams cross Brush Ridge. He sees also that this plain is the divide between two valleys, one at the east between Brush and Chestnut Ridges, and the other at the west, through which the Monongahela river flows. The latter is uninterrupted, but the former is crossed by strips of the fifteenth bench as well as by lower benches of the series, which breaks its continuity and convert it into a succession of basins. On each side the surface from the summit of Brush Ridge falls off in regular steps.

If now the observer turn his attention to the region lying west from the Monongahela river he will see that the fifteenth bench is a broad continuous plain beyond that river; but that still further back toward the west, the fourteenth, on an island of which he is standing, forms a similar plain, while still further west, the thirteenth, with an altitude of 1380 feet, stretches northward and southward, and is broken only by narrow valleys, in which the larger streams flow.

Should the observer's position be changed to Hillsborough, on the National road nearly midway between the Monongahela river and the borough of Washington, where the elevation is about 1500 feet above tide, he will see that this thirteenth bench is of great extent north and south, while back of it the country rises to a still higher level, again and again, until it reaches to 1445 feet above tide. This last bench is the ridge, which practically separates the benches of the Monongahela from those of the Chartiers Valley further west, though near the National road that ridge is broken by Pike run, along which all the lower benches of the series are shown. From the river westward to Hillsborough, or rather to the ridge passing nearly three

* The numbers are those on the last table.

miles from that place, the surface rises in a succession of steps which are beautifully marked. From the hill-top at Beallsville, three miles east from Hillsborough, the descent of these to the river is well seen. There is here, then, a repetition of the conditions shown east from the Monongahela. The diagram rudely represents the succession.



Profile of benches from Chestnut Ridge to Hillsborough.

In the valley between Brush Ridge and Chestnut Ridge, benches lower than the fifteenth fringe the several drainage areas, while the sixteenth and eighteenth form subordinate divides.

Two general questions present themselves here, the one relating to the time when the valleys were scooped out, the other to the age and origin of these benches by which the sides of the valleys are marked.

Erosion of the Valleys. The present drainage system was outlined at a very early date, in part no doubt before the elevation of any of the great axes; the Conemaugh river taking its rise on the western slope of the Alleghany Mountains of Pennsylvania, breaks through both Laurel and Chestnut Ridges, as well as the Blairsville, Saltsburg and Waynesburg axes, which are west from Chestnut Ridge; Loyalhanna, Jacob's and Dunbar creeks cut through Chestnut Ridge; the Youghiogheny has worn its way across all the main axes west from the Alleghanies of Pennsylvania; Cheat river heads against the Alleghanies of Virginia, and its deep channel-way passes by deep gaps through the Alleghanies of Pennsylvania and all other axes at the west, until it enters that of the Monongahela midway in the Saltsburg arch; while the main fork of the Monongahela river splits the Tygart's Valley axis in West Virginia, flowing for miles in a broad anticlinal valley, and after breaking through the west slope of that axis, runs rudely northwest and north, until, having cut through every axis to the Brady's Bend, it joins the Alleghany river at Pittsburgh.

It seems altogether probable that this system developed itself gradually as the land increased toward the central part of the basin, and that the great streams flowed very near their present lines before any marked elevation of the axes had taken place.

One is not fairly justified by the facts in supposing that the system was established after the axes had been elevated enough to affect the topography. Several canoe-shaped synclinals lie between the Alleghanies of Pennsylvania and Laurel Ridge; a similar synclinal exists between Laurel and Chestnut Ridges and another between Chestnut and Brush Ridges. A drainage system, like that now existing, could hardly have originated in parallel synclinal troughs separated by distinct ridges such as these mountains are. A series of lakes might have been formed, but that they would have been in communication so as to give a uniform drainage system, tending wholly westward and breaking through the axes, seems not altogether probable; for Laurel and Chestnut Ridges are little, if at all inferior to the Alleghanies of Pennsylvania, either in altitude or in the inclination of the strata.

It is equally difficult to believe that the streams now flow along lines of original weakness, crossing the several axes, or that their present courses through the mountains mark lines of transverse fracture. A transverse fracture would necessarily be parallel to the direction of the disturbing force, and it could arise only in case the rock on one side of a line has greater power of resistance than it has on the other. Associated with the transverse fracture there would be a greater or less faulting of the axis. So that there would be no difficulty in deciding the presence or absence of such a fracture; for even were the direct evidence masked by river erosion, the side throw would be distinct. But there are no evidences of such side-throws near the gaps or anywhere else in these mountains, and all the conditions go to show that any supposition of their existence is altogether improbable. For, as I have shown elsewhere,* though the axes are thrown off successively toward the southeast, yet there are no breaks. The two parts of a shifted axis overlap, one becoming gentle toward the north and the other toward the south, until each is over-ridden by the other.

In addition, such a hypothesis necessarily assumes not only that these fractures must have existed in all of the mountain axes, but also that much more extensive erosion had taken place in the region west from Chestnut Ridge than any of the more eastern troughs, in order that by deepening the fractures in the several mountain ranges, the waters could be drawn off into the next trough west.

While neither the hypothesis nor its attendant assumption goes beyond the range of possibility, each oversteps very far the bounds of probability. Erosion must have been going on all the time east from Laurel Ridge, while the valleys were deepening on the west side of Chestnut Ridge; and a system of drainage must have existed in one region just as well as in the other; unless, indeed, the region east from Laurel Ridge was arid, which is wholly improbable. If these systems were not one from a very early date, it is difficult to conceive how they could become one at any later date; at all events it would be impossible by any natural deepening of gaps or removal of divides to divert the drainage from one side of an axis to the

* Reports on Fayette and Westmoreland Dist. of Penn.

other in a region like this, even were the ridge no greater than Brush Ridge, which marks the course of the Saltsburg anticlinal.

The accuracy of this statement will be apparent at once to one standing on the National road at the summit of Chestnut Ridge, where on the west he sees deep gorges made by Redstone creek, while on the east side he may look down into the almost equally deep gorges made by Cheney's run. The water from the former flows to the Monongahela by way of a close gap through Brush Ridge; while that from the latter, flowing against the dip of the rocks, which rise southward towards the point of the Ligonier canoe, passes by way of Sandy creek to the Cheat river. Each stream has a rapid fall, so that no possible cutting down of the divide by natural operations would suffice to divert the drainage from one side to the other.

Altogether the more probable hypothesis, therefore, is that the main streams flowed along or near their present lines before the axes, which they cross, had been elevated so as to affect the topography; and that the gaps were eroded during the slow elevation of the folds. This process has been well described by Mr. Gilbert in his *Memoir on the Geology of the Henry Mountains*, and Maj. Powell has given instances where it is clearly impossible that the disturbance could have ante-dated the erosion. Some of these are analogous to the ones under consideration.

The great length of time which has elapsed since this erosion began is shown not only by the general wasting of the surface between the axes, but also by the structure of the gaps; for in these, above the highest river terrace, the walls slope with comparative gentleness, and in many places they are deeply trenched by streams flowing directly along the axial line; whereas below the line of the highest river terrace, the walls are abrupt. The same conditions exist in minor gorges made by such streams as George's creek, Redstone creek, Jacob's creek and Sewickley creek through the axis of Brush Ridge, for there also the lower part of the gorges has abrupt walls, while the upper part is wide, with walls sloping gently toward the streams. It will be understood, of course, that there are occasional exceptions to this general statement of the conditions.

That the erosion of the valleys ante-dated the formation of the horizontal benches is shown by the distribution of the benches themselves. These appear in many localities only as the crowns of flat-topped hills; the fifteenth is an extensive plain along Brush ridge, but between that and Chestnut Ridge it occurs only in the crowns of hills or as the summit of narrow strips stretching from one ridge to the other. Some benches are seen only along the mountain slopes, while others line both sides of narrow valleys reaching far from the rivers into the interior of the counties. All of the terraces below the twelfth are shown along Pike run in Washington county, though that stream breaks through the ridge which shows the highest benches seen west from Chestnut Ridge. For this reason, one riding from the Monongahela to Washington along the National road frequently descends from higher benches to lower ones and finds them all equally distinct. The lower benches can be seen along the

valleys for a considerable distance from the National road towards the river, and when followed out they are found to be continuous with those previously crossed on the road.

Age and Origin of the Horizontal Benches. The surfaces of these benches are still level, and in many places the escarpments are so nearly perfect that one has difficulty in believing that the flat-topped hills are not ancient fortifications. The detrital covering is well preserved, though it consists only of loose sand with occasionally a little clay.

Some may suppose, that, in measure at least, these benches are creatures of the imagination and that they are merely such as must occur in a region where the rocks are of unequal hardness and are horizontally stratified. But such a supposition would be wholly erroneous. The rocks are not horizontally stratified and the benches bear no relation whatever to the dip of the rocks. Thus in Springhill township of Fayette county, on the west slope of Chestnut Ridge, the rocks dip at from 4 to 6 degrees toward the north-west, but the fifteenth bench is as level there as it is on the side of Brush Ridge, eight miles away, where the dip is but one degree, or at Uniontown, ten miles away, where the dip is three degrees, or at any other locality within the whole region. That no relation exists between the stratification and the benches is a fact which cannot be stated too positively.

It has been suggested that these benches may be regarded as marking base levels of erosion, such as have been described by Maj. Powell. In defining the term, that author uses the following language: "We may consider the level of the ocean sea to be a grand base-level, below which the dry lands cannot be eroded; but we have for local and temporary purposes, other base-levels of erosion, which are the levels of the principal streams which carry away the products of erosion."

As Major Powell states, the term "level" is used with some freedom in reference to stream-beds, and the term base-plane might have been more apt. Major Powell notes the fact, that, for all practical purposes, a stream ceases to deepen its channel-way long before the bed has reached the level of the lower end of the stream. If I understand the doctrine aright, it is, that after the corrasive energy of the stream has reached its minimum, it is less rapid in its effect than the wasting away of the adjoining surface; so that eventually the whole region will be worn down to a slightly inclined plane, having about the same altitude with the base-line of erosion or the bed of the stream.

It is with some hesitation that I venture to disagree with those who would explain the phenomena on this hypothesis, for they have had opportunity for very extended study of surface geology; but the explanation is insufficient here, and is open to serious objections, some of which are almost insuperable.

The wide-spread horizontality of the benches seems to conflict with any such explanation. One can conceive that all the streams feeding the Alle-

ghany and Monongahela could reach the limit of corrasion at the same altitude above tide, and that, after that limit had been reached, the tributaries of those streams could continue to eat away the surface until at length a broad and almost horizontal bottom might be formed on each stream, all having the same elevation. But such a condition is inherently improbable. Aside from that, it would not suffice to explain the phenomena, for the benches would not be horizontal, they would be river terraces, with a gentle slope down stream.

If the plains of south-east Pennsylvania and the adjoining region have resulted from any such process as that described by Major Powell they must be very ancient; for although the rainfall has always been very great in this region, yet that very excess of rainfall has been the means of preventing too rapid erosion by encouraging the growth of vegetation. In like manner, if the plains had originated as suggested, they would necessarily ante-date the tremendous erosion by which the valleys below have been scooped out; for often they are shown only by the leveled tops of slender hills; they must be fragments of once continuous plains, which have been broken up by the erosion producing the valleys as they now exist. It is needful then to thrust back their origin to a time when the drainage was in its infancy.

In this case the origin might seem to be readily explained. It may be said that when the drainage was in its infancy the fall of the streams was insignificant; that if the drainage existed before the mountains rose, and the corrasive power of the streams was equal to or somewhat greater than the rate at which the axes were elevated, there would be no difficulty in understanding the formation of the benches; for since the flow was gentle the limit of corrasion would soon be reached and erosion would soon produce the benches, so that at each elevation of the land a new bench would be formed.

But all this appears to be in discord with the facts. The benches could not have been formed during the elevation of the axes, for the rocks were not lifted vertically; the elevation was effected by a lateral thrust which wrinkled the rocks. It would have wrinkled in like manner, any stratum resting upon them, and the horizontality of the benches would have been destroyed.

The phenomena, too, are too recent; the deposits are too well preserved. If horizontal plains, such as these, had existed so long ago, those plains would not have been in existence to-day. It is incredible that in a region with great rainfall, perfectly horizontal plains should remain unbroken, while valleys, hundreds of feet deep, were being digged out below them. As already stated, the deposits on these benches consist only of loose sand with occasionally a little clay. If the benches were of ancient origin this covering would be absent; the flat crowns of the hills would be rounded, especially where the rock was a soft shale as on Chestnut Ridge and in the Ligonier Valley, where, however, the horizontality is complete and the benches particularly well preserved.

But the character of the deposit on these benches shows that it could not have accumulated under such conditions as must have existed had the plains resulted from lateral corrasions by streams with but slight fall. Under such circumstances, as has well been shown by Maj. Powell, the debris torn away by tributary streams would be distributed over the widened flood-plain of the main stream and would not be washed away by that stream. Such a deposit would contain many transported fragments, fragments, indeed, of rocks belonging not far away, but showing distinct traces of water-wear, for their motion would be slow and their exposure long-continued, owing to the slight fall of the transporting streams. No small period would elapse from the time of tearing them from the rock to that of depositing them on the flood-plain; and during all this period they would be subjected to the action of water.

This condition is well shown on the great plains stretching eastward from the Rocky Mountains for hundreds of miles and finally merging into the prairies of the Missouri-Mississippi Valley. These plains are covered with a deposit which originated certainly according to Maj. Powell's doctrine. The character of the deposit is shown in the channel-ways of all the streams. On top is an irregular layer of fine silt, which rests on a mixed mass of fine silt, gravel and large water-worn fragments; while, above all, over the whole surface, water-worn fragments are freely strewn. The higher benches toward the mountains as well as those on hills far out in the plains show a similar covering. The coarser beds of gravel are often cemented by carbonate of lime into firm conglomerates. But this is not the character of the deposit on the horizontal benches of the region under consideration. As has been said so often in this paper, the deposits on these benches contain no water-worn, transported fragments; the only fragments found belong clearly enough to the underlying rocks, and show no signs of having been subjected to the action of running water.

The doctrine of base-levels of erosion, though adequately and beautifully explaining the conditions existing in the arid regions of the far-west, fails to account for these horizontal benches in the Alleghany region, one of great rainfall. These plains are too widespread, too nearly horizontal and parallel, too recent and too nearly free from traces of running water, to be regarded as marking base lines of erosion referable to stream beds.

It is impossible to account for the phenomena on the hypothesis of a great flood's sweeping down over the whole region, for the action of such a flood would be too violent to produce effects such as have been described in this paper.

The benches bear much resemblance to beach lines, marking successive stages of emergence from a body of water; but they are not due to base-level erosion in the full sense of that term in this connection. The areas of the benches are so insignificant in many places that they could not have been leveled by water falling on and flowing off the surface. Such a process would require a vast length of time, altogether too vast in view of the

freshness of the detrital covering on the highest benches. More than this if the time were long enough to admit of leveling the insignificant areas by ordinary erosion, it was not too short to admit of leveling the larger areas and of removing the mountains during the successive stages. But no such leveling exists; on the contrary the mountains and hills still exist, and the numerous benches are found on their sides.

Had the phonomena been observed only on the west side of the Alleghanies, there might have been room for supposing that the benches resulted from the draining away of some great lake; but this hypothesis would be useless, since one would have difficulty in finding a sufficient barrier at the south or west for the retention of the water. For in those directions the surface falls away so rapidly that in the whole of south-west Pennsylvania and West Virginia, west from the mountains, it rarely rises to even 1500 feet above mean tide. But there are distinct benches at 2400 feet above tide. A temporary barrier, 1000 feet high, is beyond the reach of even the most indolent credulity.

The conditions suggest that these benches were formed by ocean wear between tides. Their horizontality and their excessively comminuted deposits go far toward supporting this supposition. The features closely resemble ancient sea-beaches in other parts of the country. Such a supposition involves a submergence to a distance of more than 2500 feet above the present line of mean tide; and the submergence would have to be somewhat greater to account for the even crests of the Alleghanies and other ridges west from the Blue Ridge. Horizontality of crest characterizes all those ridges as far south, at least, as the New river of West Virginia, for there they look, not like mountains as generally understood, but rather like a succession of gigantic waves which have not approached near enough the shore to show signs of breaking.

To some, perhaps, the absence of marine fossils may be regarded as a vital objection to this hypothesis. But not so. The detrital covering is loose, not compact, and the occurrence of fossils would be cause for surprise. Their absence is not.

Immense deposits occur in the Rocky Mountain region which are unquestionably of marine origin, yet over great areas they contain no traces of fossils. The enormous red sandstone seen along the east face of the Rocky Mountains in Colorado, is to all appearance devoid of fossils. Similar conditions exist in the sandstones of the Upper Cretaceous or Lignitic series in by far the greater part of Colorado and New Mexico. They frequently contain fucoids and remains of other plants, but animal remains are absent from the loose rocks. But here and there calcareous or ferruginous materials have rendered the rocks compact, and in such cases animal remains do occur.

Of like character is an instance mentioned to me by Prof. Geikie. A Lower Carboniferous sandstone in Scotland is celebrated as a repository of fossil trees; but though searched diligently at many localities during a whole generation, it failed to yield even a single relic of animal life until

November of 1877, when a Mytiloid shell, which is associated with *Orthoceras* and other forms of marine life elsewhere in the district, was found inside the cast of a *Lepidodendron*, where it had been preserved by the superior hardness of the material in which it was imbedded.

If fossils were ever present in the detritus covering these benches, they have been dissolved out by ordinary water or by water carrying carbonic acid in solution. As the coating is merely incoherent sand, all animal remains would be leached out of it in a comparatively short time, while fragments of wood, which occasionally occur, would be unaffected. Instances of this kind are common enough, so that they need not be referred to in detail.

An objection to the marine origin of these benches may be found in the existence of fresh water forms on the summit of Chestnut Ridge. That such forms do occur there seems to be altogether probable from the testimony of several persons, but I have been wholly unable to discover the localities, although I have made diligent search. The shells obtained at the summit of that ridge near the National road could not have been numerous, for close examination of the sand on several occasions yielded not even a fragment.

If remains of fresh-water mollusks do occur on the crest, they mark places once occupied by ponds such as those now to be seen at a little way north from the National road and very near the summit. The presence of the great Lower Carboniferous limestone is exceedingly favorable to the growth of mollusks. This explanation is the more acceptable because according to the statements made, the specimens are too well preserved to admit of the supposition that they had been entombed for any considerable length of time. They still retain the epidermis. Such being the case their presence has no bearing whatever on the age or origin of these benches.

If these benches are old beach lines, as seems by no means improbable, they show that, at some period since the glacial time, the sea has covered the greater part of the continent, certainly submerging the present summit line of the Alleghanies in Pennsylvania. This would confirm the surmise offered by Dr. Hitchcock in his "Illustrations of Surface Geology," when discussing the sea-beaches found along the streams of New England.

The lowest of these benches is at 1100 feet above tide. This statement holds good only for the extreme north-western part of the area examined In the Ligonier Valley the lowest horizontal bench is at a greater altitude, so, also, in southern Somerset county. Of necessity the horizontal benches ceased when the drainage was re established, that is when the line of submergence sank below the stream beds previously existing. When the water sank below 1100 feet, it fell below that level in this region and the lower series of terraces began to form; but further west and south-west, where the elevation of the country is less than within the area described, horizontal benches should be found at altitudes less than 1100 feet above tide, possibly down to within a very little way above the tide-level.

The River Terraces.

The river terraces fall down stream and are covered by irregularly bedded sand, clay or gravel, containing transported fragments which have been rounded by the action of running water. When followed up the streams these terraces show differences among themselves in degree of slope, so that each is merged successively into the next higher, until that, which at the mouth of the stream is the river "bottom," becomes the only terrace and is lost at last in one of the lower horizontal benches.

For the most part the terraces occur at the same elevation on both sides of the stream, being divided by the channel-way just as the present "bottom" is divided. Sometimes a single terrace and occasionally the whole series of terraces is wanting on one side of the stream. In such a case it is clear enough that erosion was confined to one side so as to remove all traces of the terrace or to prevent the formation of the terraces, just as is seen in the present channel-way, the "bottom" being present often on only one side while stratified rocks reach to the water's edge on the opposite side.

As stated in my report on the Greene and Washington district of Pennsylvania (1875), these terraces are merely shelves in the rock, on which a thin coat of detritus rests. Mr. G. K. Gilbert, in his Memoir on the Geology of the Henry Mountains, describes the occurrence of similar terraces in those mountains.*

These terraces then do not fall in the same category with those described by Dr. Hitchcock in his "Illustrations of Surface Geology," for those had been eroded from valleys previously filled by gravels. No evidence has been found suggesting that any valleys of that sort exist in the region under consideration, while there is good reason for believing that the valleys lined by the river terraces, described in this paper, were not in existence to be filled with gravels.

The terraces below Pittsburgh on the Ohio river are covered by a deposit consisting largely of northern drift brought down by the Alleghany and Beaver rivers. No such material is found along the Monongahela and other rivers south from the Ohio, as they flow altogether beyond the southern limits of the drift. But their age is as clearly shown as is that of the terraces on the Ohio. The fifth terrace, at New Geneva, on the Monongahela, has a layer known as the "Swamp Clay." which contains much half-rotted wood. With the wood are berries like those of the black haw and in the same clay a well-preserved acorn cupule was found. In the same vicinity, as well as near Morgantown in West Virginia, the third terrace shows many *Unio* shells in an advanced stage of decay, while at Belvernon, on the Monongahela, much wood is found on this terrace. That the third terrace is older than the second and that this is older than the river

* This work has not been published at the time of writing, but Mr. Gilbert has very kindly given me a set of plate files for use during the preparation of this paper. It contains an elaborate discussion of the whole subject of land sculpture, embracing the results obtained by Mr. Gilbert during his long study of the Colorado Plateau.

"bottom," is sufficiently proved by the condition of the *Unio* shells on the several terraces. For those on the first are fresher than those on the second, and those on the second are fresher than those on the third; while the species on all are apparently the same with those now existing in the river.

Since the deposits on the first, second, third and fifth terraces are distinctly of recent origin, there would seem to be good reason for supposing that the valleys below the highest of the terraces are also of recent origin. It has been suggested, however, that the terraces resulted only from reworking of the sides of valleys which had been digged out previously. But this suggestion seems to be hardly in accord with the facts.

It must be remembered that the streams flow on a rock bottom, so that the beds are now at the lowest point ever reached by them; that there is no evidence thus far, going to show that any gravel deposits ever existed along the Monongahela, so as to make its valley like that of the Ohio at Wheeling or Steubenville; that the deposits on the terrace shelves are not remains of valley gravels, but simply accumulations of material brought down by the streams and distributed as the matter has been distributed on the present "bottom." Rocky banks are shown at the mouths of tributary streams. Had the valley been filled by gravels, it is incredible that even the most comprehensive erosion could have failed to leave some trace of their existence.

The structure of the valleys below the highest terrace is very different from that observed above it; for in the upper portion the sides are gently sloping, whereas below the highest terrace they become steep almost at once. Above the line of that terrace, the valleys of the smaller streams are broad swales, with smooth sides, while below that line the streams usually flow in gorges. The abruptness of this transition from gentle to abrupt walls shows that erosion had been long at work on the upper part of the valleys and that it began in the lower part at a comparatively recent period; in other words, that the lower portion was eroded after the upper portion had acquired its present form.

The river terraces are relics of river beds, such are the present "bottom;" and the valleys below the line of the highest river terrace have been eroded since the drainage system was re-established by withdrawal of the submerging flood to below the line of the former stream beds.

Conclusions.

The general conclusions which seem to flow readily from the facts recorded are:

First. That the erosion, to which is due the general configuration of the surface above the line of the highest river terrace, began even before the elevation of the anticlinal axes and continued until the region was submerged in post-glacial time.

Second. That the horizontal benches are due to the re-working of pre-existing valleys, and that they mark stages of rest during the emergence of the continent from the submerging flood.

Third. That the river terraces and the valleys, which they line, were formed after the drainage system had been re-established by withdrawal of the water to a level below that at which the streams had previously flowed.

It will be seen that the last conclusion leads to one of wider application.

So long time had elapsed between the beginning of this drainage and the coming of the great flood, that deepening of the water-ways had become not more rapid than the general wasting of the adjacent country; for we find comparatively gentle slopes down to the line of the highest river terrace. But after the drainage had been re-established, the rate of flow must have been more rapid than before, so as to increase the corrasive power of the streams to far beyond what it had been, for in the newer parts of the valleys the sides are abrupt. There must, therefore, have been a change of altitude with respect to tide-level, to lead to this increased rate of flow and the consequent increased speed with which the channel-ways were deepened.

It would appear then, that, after the submergence following the glacial period, the continent rose to a greater height than it had before the submergence, or that the ocean was drawn off to a lower level than before; the result in either case being the same—to depress the mouths of the great rivers, to increase the fall of the streams, and therefore to cause the deepening of the channel-ways.

The Philosophy of the Biblical Account of Creation.

By Aug. R. Grote, A. M.

(*Read before the American Philosophical Society, September* 19, 1879.)

Mr. Grote introduced his subject with a list of works which he had consulted, by the following authors: Keil, Kuenen, Colenso, Bleek, Sharpe, Haverick, Geiger, Goldziher, Geo. Smith, Delitzsch, Cory, H. C. Rawlinson, Geo. Rawlinson, Von Herder, Arnold, Spiegel, Simrock, Max Müller, and Prof. Adolf Duschak.

He then gave in brief the historical distribution of the Shemitic languages and their literary remains; following this with the Hebrew text (in English letters) of the first two chapters of Genesis, and in opposite columns his own translation, with that of the authorized English version in parenthesis, thus:

20. Vayyomer Elohim Yishr'tzu hammayim sheretz nefesh chayyah v'of y'ofef alha aretz, al p'nay rakeeah hashamayim.*	20. And Elohim (God) said: Let the waters abound with (bring forth abundantly) creeping (the moving) creature living (that hath life) and fowl shall fly (that may fly) above the earth in the face (in the open) of the expanse (firmament) of heaven.

*Syntactically the word "v'of" (and fowl) besides being the subject of "y'ofef" (shall fly) may be the object of "Yishr'tzu" (abound with). The common English version gives it exclusively as the object, and supposes a relative pronoun understood.

And to this verse he drew special attention, subsequently, as showing that in the Elohistic Genesis the fowls were described as created out of the waters; whereas in the Jehovistic Genesis (2 : 19) it is said:

Vayyitzer Yahveh Elohim min ha-Adamah kol chayyath hassadaih v'aith kol of kashshamayim vayyabhai el ha-adam, &c.	And out of the ground Yahveh Elohim (the Lord God) formed every beast of the field and every fowl of the heaven (air) and brought (them) before the man (unto Adam), &c.

The "literary criticism" with which the author follows these chapters discusses the evident distinctness of the two narratives.

"They differ in almost every particular, in the arrangement, in the facts, in the name of the Deity, in their object, and lastly, in the language used. The different arrangements of the two accounts need hardly be pointed out.

"In the first account we have an orderly progression, a subdivision of the whole drama into acts. After each act, occupying a day, the curtain drops; the work must have been done in the night, as the day begins with the evening, although we are somewhat puzzled to understand how the author could have imagined 'evening and morning' before the creation of the sun.

"The second account, on the other hand, beginning Ch. II, 4, has no division of time at all, nor is there an orderly subdivision of events; all events are only told with reference to one central fact, the creation of man. A comparison of the facts narrated in each shows the following differences:

"The first account begins with Chaos, as in the Greek Cosmogony, the first differentiation being between light and darkness on the first day. The second day brings about the division between heaven and earth. On the third, land appears.

"The second account opens with the earth as a dry arid plain without vegetation and animal life.

"In the first account the earth is made to produce the herbs bearing seed and the trees bearing fruit with seed, independently of rain and human interference.

"In the second account the herb of the field does not grow until it has rained and man has tilled the ground, though we are not told whence he obtained the seed to plant, nor how the uncultivated plants originated. Man, however, appears *first* on the ground, while in the first account he is the *last* object of creation. In this act itself a variety of divergencies may be noted.

"In the first account man is made in the image of Elohim, in the second no mention is made of his "god-likeness," on the contrary we find that it was quite against the will of the Deity that he should become so. And after he had become so by the advice of the serpent and the curiosity of Eve, he

is driven from the Garden of Eden for, says Yahveh Elohim (Ch. III, 22), 'Behold the man has become like one of us to know good and evil," exactly as the serpent had foretold in the same chapter (verse 5) : "for Elohim knows that on the day of your eating therefrom, your eyes will be opened and you will be like Elohim knowing good and evil.

"In Chap. II, 27, man is created, male and female.

"In the second account woman appears only after a surgical operation.

"In the first account the birds appear on the fifth day, the wild beast and *domesticated* cattle at the beginning of the sixth day, after which follows the creation of man, male and female.

"In the second account Adam is first made alone, in a manner to which we find no reference in the first account. Then the 'beast of the field and the fowls of the Heaven' are made by Yahveh Elohim from the ground before woman is created. Mark also, that first beasts and then fowls are made by Yahveh Elohim himself, out of the ground, in the same way as Man ; but in the first account the fowls are produced, at command on the fifth day, out of *the water*, and beast and cattle are brought forth by the earth on the sixth day.

"The first account knows nothing of the Garden of Eden, of the four rivers, of forbidden fruit, of the naming process and of matrimony.

"The second does not mention the creation of heavenly bodies, of the fishes and 'whales,' and of creeping things. It knows nothing of 'festive seasons' and of the Sabbath.

"In the first account Man is given unlimited control over the whole earth and all animal creation; in the second he is simply the gardener of Eden."

He next discusses the difference between Elohim and Yahveh Elohim as names for the Creator, and infers that the first account was penned by an Ephraimite, and the second by a Levite, who omitted mention of the Sabbath because the Levitic tendency was to refer all festivals to the Exodus, the Sabbath included (see Deut. 5 : 15); whereas the Elohistic Sabbath was an adaptation from the planetary (Saturn) worship of pre-Levitic times. "The Hebrews were undoubtedly Zabeans in the early stages of their development; in evidence of which we have the word *Shabbah*, to swear, from *Shebbah*, seven ; *i. e.*, swearing meant to call the seven stars or gods to witness. We find Amos (5 : 26) reproaching them with worship of *Keeyun*, Saturn."

"The Yahvistic account has a different object in view. When it was committed to writing the priestly dominion must have been already very pronounced." "We hear Yahveh declare (6 : 5) that the wickedness of man was great on the earth, and the instinct of the imaginations of his heart was only evil day by day." "Cain and Abel bring sacrifices" (4 : 3,4). "In the history of Noah we find the distinction of clean and unclean beasts."

"From the geographical notices (v. 10, 14) we may learn that the trade

with India, opened by Solomon (1015, 975 B. C.), must have settled down to staple articles."..... "Considerable time elapsed from the first partnership of Solomon with Hiram, before India became well known and its gold proverbial." "The Euphrates was the chief river.....since the main troubles of the Israelites originated thence."

The author then gave a chapter on the "Testimony of Archæology," describing the Assyrian tablets of the Genesis, Deluge, &c., and laid special stress on the occurrence of the deity *Il* in the Chaldean Pantheon, "standing at its head, the fountain and origin of deity, equivalent to the Hebrew *El, Eloah*, with its plural *Elohim*, and of the Arabic *Allah*."

"The word used in the Hebrew text of Genesis, and translated God, is Elohim, a plural, but the verbs and pronouns agreeing with it are all in the singular, excepting in the account of the sixth day. The twenty-sixth verse of the first chapter of Genesis reads, 'And Elohim said: Let us make man in our image, after our likeness.' The twenty-seventh verse again returns to the singular by beginning, 'So Elohim created the man in his own image, in the image of Elohim created he him.' We see then the noun signifying the Deity is plural, but conceived as a unit in its creative power.

"And now let us look at the first verse of the account of the fourth day and the fifth Chaldean tablet quoted above in full. 'It was delightful all that was fixed by the Great Gods (*Illinu*, Hebrew *Elohim*) stars their appearance in figures of animals *He arranged*.' Exactly as in the Hebrew text, the noun is in the plural and the pronoun and verb in the singular, and this is kept up throughout the whole account. Thus, under the test of the linguistic crucible, this difference also gives way and the identity of the Hebrew and Chaldean accounts, not only in their incidents, but even in their fundamental mythological notions must be accepted as proven."

He then discussed the probable date of the Chaldean originals of the Assyrian tablet stories, and "the conclusions....reached may be thus briefly stated: The legends having existed for a long time as oral traditions, were committed to writing before the union of the kingdoms or before 2234 B. C., when Abraham, according to Biblical chronology, was not yet born. The earliest date assigned to the composition of the Biblical records is the time of Moses; this date is positively established through hieroglyphical inscriptions to be that of the king Menephthah, the Pharaoh of the Exodus, who followed his father Rameses II. on the throne in the year 1245 B. C. According to this the Chaldean account of Genesis would be nearly 1000 years older than the composition of the Biblical legends."

After giving "parallel myths" from other races and nations, the author concluded his paper with "The testimony of facts."

"At the outset it will be seen to be foreign to our purpose to introduce here any evidence in proof of the reality of the process of Evolution. But the existing evidence that things have been brought to their present condition by a slow process of succession, in which the more simple forms pre-

ceded the more complex, is unanimously conceded by all who have investigated any branch of natural science, and effectually contradicts the sudden and separate origin of things deducible from the account in Genesis. With this, it will be sufficient if we point out in a brief way the facts discovered by science which contradict the account of creation in Genesis, whether we accept the sequence of plants and animals revealed by a study of fossils and living kinds, as indicating a genetic connection, or as being insufficient grounds for such a conception.

"From internal evidence, Genesis is not homogeneous in its composition, as we have already seen. An originally detached portion having a different immediate source, terminates with the third verse of the second chapter, and it is quite evident that in dividing the text into chapters a mistake has been committed in this instance; the second chapter should begin, if an arbitrary division into chapters is intended to help the comprehension of the text, at its fourth verse. That these two accounts contradict each other is plain. The first account affirms that when God created man, 'male and female created he them.' The second account as positively declares that man was created in the person of Adam as one sex and solitary. Finding that such a creation was incomplete and useless, the Deity made woman not out of the ground or dust, but of a bone of man himself. At one time one can readily conceive that such a belief could be seriously entertained when we read the accounts given by existing savages of their own origin. But it never for one moment occurs to us to credit such conceptions. The idealists have been busy with this account of the origin of woman. It is taken as symbolical of the marriage state, of the dependence of woman upon man, 'bone of his bone, flesh of his flesh.' But to the uncultured races *their* fairy-stories are real, they believe them as Roman Catholics believe modern miracles and Protestants ancient miracles. Among the people who originated this fairy-tale of the origin of the first pair, the story passed for circumstantial fact. It satisfied their natural enquiry as to the origin of things, and it arose out of their mental status. But to ask us, who have gone beyond their mental condition, to still accept it as true, is unreasonable, and it is quite impossible that we should comply with such a request.

"In the second account the events of creation are given in a different order from the first, and this account is throughout more circumstantial. The Garden of Eden is described, and this has been lately identified with the mythological center of the ancient Chaldean Pantheon. Before both accounts were cast in their present fossil condition in the Hebrew Bible, they probably had a connection, as we have seen in a preceding chapter, and had undergone a development in which both had lost something of their original form, the first account more, the last less.

"The first account in the first chapter of Genesis may be now compared with the facts ascertained by science. We must believe that the text should be understood literally when it speaks of 'day' and 'night,' because with this reading it agrees with the context. From the alternation

of light and darkness sprang 'day' and 'night,' and 'the evening and morning were one day.' To take these *days* as *indefinite periods* is a proof of want of exact thought, it is an effort to reconcile an exploded statement with the new facts, rather than cut loose at once from demonstrated error. The Hebrew word *Yom* not only means a day of twenty-four hours, but it expressly means *day* in this connection.

"But even granted that we take the less natural meaning of the word 'day' as the proper rendering, and that by this word 'day' any conceivable measurement of time is intended, it is only on the fourth of these days that the Sun appears. Astronomy, if it shows anything, proves that the satellites of a central orb, as separate masses of matter, must have been projected from it and at one time formed a part of such a body. The relation between the earth and the sun, as we gather it from astronomical sources, is a different one from that intended by the account in Genesis. We cannot conceive that the sun or the moon were created for the benefit of the earth or its inhabitants. Night and day are not necessities in the sense that we could not have become accustomed to some other division of times, for darkness and light, as indeed the Eskimo now are. Our organs of vision have plainly adapted themselves to the light which evidently existed before eyes were developed. And as to the succession we find that the earth is the child of the sun and the parent of the moon. But, that such a succession was comprehended by the writer of Genesis cannot be maintained. He undoubtedly believed that the sun and the moon were created for the benefit of the earth, which he did not know was round and a satellite, but imagined as flat and the center of the system. Light is also conceived of as independent of the sun. Plants bearing 'seed and fruit after their kind,' are regarded as being created before the sun, whose rays, the physiological botanist now shows, alone give them health and vigor. Again, whole groups of animals of whose remains mountains are made, such as corals and rhizopods, are omitted from the account. Such an omission, if it tallied with the restricted knowledge of the times in which such an account was believed, proves conclusively that the account was not extraneous, or in any way above the level of ancient civilization. And undoubtedly it does so tally, and the most powerful argument against Genesis, for those accessible to reason, lies in the fact that it contains no information superior to a very low grade of observation in natural history. Later on, in the magnified and equally improbable story of Noah's ark, we find no mention of the rescue of the plants or how they stood the flood. At that time it was simply not known that plants breathed like animals and would drown as well as they.

"The records of the rocks tell us unmistakably that plants and animals have flourished through untold ages side by side, new forms succeeding old ones. But in Genesis, the creation of trees and shrubs took place in a period perfectly distinct from animals. The paleontologist must, then, reject the account of Genesis as perfectly incredible. Again the distinction between the 'beast of the earth after his kind and cattle after their kind,' shows

a belief that domestic animals were created in a state of domestication. The Hebrew word *b'hemah* means cattle, *i. e.*, domesticated animals, in contradistinction to wild animals. The other term *chayah* means wild beasts, in contradistinction to tame animals. The use of both terms shows that both kinds were believed to have been created 'after their kind,' and as distinct species. There is nothing contradictory in the conclusion that the statement was at one time believed in, because savage man still believes in parallel assertions, and this particular belief was generally current in Europe before naturalists had shown its contrary to be true, and that all domestic animals were originally wild and by man's selection have been changed from their original physical condition. A vegetable diet is also assigned at first to beasts and man, but the physiologist knows that carnivorous animals have always existed and that the instincts of animals are true to their teeth.

"The story of Genesis takes no account of the different races of mankind nor of prehistoric man. Its chronology is recent and special. All attempts to consider it as merely omitting to mention these facts, which it could as well have given, must be rejected as defective reasoning. If it could go so far as to note the creation of cultivated races of beasts, such as cattle, it should not have failed to note the more important races of mankind. The character of the fauna of the country in which the myth originated is stamped on the face of the recital. All attempts to consider it as the true Genesis of the white, or Semitic and Aryan races, and therefore as reliable to this extent, must likewise fail. The history of the descent of man is not yet written, but, so far as we have the facts, they make for the view that the negro is a geographical variety, thrown off from an ancient stock of mankind, and therefore not an older stem through which mankind has passed to become white.

"Finally, at no time can it be true to say that 'thus the heavens and earth were finished and all the hosts of them." Change in all nature is the well attested truth, and this change has never relaxed its endless procession.

"Unessential as much of the scientific criticism directed against the ethical portions of the Scripture is seen to be, such criticism must be appropriate when directed against a portion which deals almost exclusively with statements of facts.

The Gods of the two accounts in Genesis expressed by nouns plural in form mark a reminiscence of a preceding plurality of deities and are plainly not coincident with our modern conception of the Deity. The notions of the Bible writers about God are not the same as the notions of the Israelites during the times of which the Bible writers treat. And our notions about God are not the same as those of the Bible writers. There has been on the one hand a growth in the direction of a recognition of an universal God, who at one time was tribal and national; and on the other hand there has been a progress in the direction of a recognition of one God, the final cause of Nature, who has absorbed the minor deities into himself.

This last change runs parallel with our progress in science and philosophy. We have gradually come to the knowledge that the laws which govern Nature are related and correlated and it is now no longer necessary to have a separate God for each phenomenon. But our Gods were those of the Aryan nations, Greek and Roman, Indian and Scandinavian, and these nations were behind the Semitic in the expression of monotheism. In fact we came by our present and popular monotheism suddenly through Judaism in its form of Christianity; while the monotheism of the Hebrews was not fully expressed until the eighth century before Christ. Moses, as has been abundantly shown, was not a monotheist. In the ten commandments, which in their ideas are certainly his, we find the expression, "Ye shall have no other Gods before me (Yahveh)." This carries the force of an acknowledgment that *after* Yahveh, and as of inferior rank and power, other Gods might be worshiped. The monotheism of the Israelites is more especially a development on the side of morality. Yahveh is the High and Holy One; a broken and contrite heart He will not despise! By giving Yahveh the character of supremacy the first steps towards a pure monotheism were slowly established; and the straight line of the best conduct being recognized, it was easier to reach monotheism by this route than by an intellectual acquaintance with the forces of Nature, upon which the Indo-European mind, before its contact with Judaism, principally concentrated its powers. But in the mythology of Aryan nations a progress towards monotheism can be shown; only the Aryan idea is more abstract and intellectual, the Semitic concrete and moral. As soon, therefore, as Judaism was offered as the true religion for Aryan nations, it was only accepted in its dilution of Trinitarianism. It is now the province of science to demonstrate from the intellectual side the truth of the monotheistic philosophy. But, undoubtedly, the prime error of the orthodox Biblical expounders, as also the error of the Bible writers themselves, is the measuring of past epochs by present conditions.

"In the Biblical story of creation we have to do with a myth, which had undergone many changes before Genesis was written. Since that time and when the latter could no longer change, many differing conceptions of the origin of things have found their orthodoxy in a play upon the meaning of the words and a distortion of their original intent. A lax wording, a shorter and more general statement, a monotheistic conception, gives an elasticity to the story of Genesis and a certain adaptiveness to later discoveries; but in its treatment of the heavens and the heavenly bodies, in the little bit of the earth on which its miracles are performed, it is still akin to the notions of the Homeric ages with regard to the Universe."

The Cosmogony of Laplace. By Daniel Kirkwood, LL.D., Bloomington, Indiana.

(*Read before the American Philosophical Society, Sept. 19th*, 1879.)

Laplace's celebrated nebular hypothesis was first distinctly stated in his *Système du Monde.** The reasoning by which it is there sustained is general, and it does not appear that the author made any effort to test his theory by analysis. The law of the conservation of energy was then undiscovered, and hence data, which now seem available for a critical examination, were entirely wanting. Let us consider the hypothesis in some of its obvious aspects.

1. It is assumed by Laplace that nebulous rings were abandoned only in the vicinity of the present orbits of the planets. While I have for many years believed that the matter of the solar system originally existed in a gaseous condition, and hence that *a* nebular hypothesis in *some* form must furnish the true explanation of the planetary motions, I have more than once ventured the opinion that this assumption of Laplace is wholly unwarranted. I make a single quotation from the Monthly Notices of the Royal Astronomical Society for January, 1869 :

"The known facts in regard to the zone of minor planets, as well as the phenomena of Saturn's rings, seem to demand a modification of the nebular hypothesis as generally held. No reason has ever been assigned why the solar nebula should not have abandoned rings at distances intermediate between the present orbits of the planets. On the contrary, it seems highly probable that, after first reaching the point at which gravity was counterbalanced by the centrifugal force arising from the rotation of the contracting spheroid, a continuous succession of narrow rings would be thrown off in close proximity to each other, and revolving in different periods according to Kepler's third law."

The view thus expressed in 1868 has never been called in question, and I have seen no reason to modify it. The *ring* theory thus seems to require that after matter began to be thrown off at the equator of the revolving mass, the process should have been almost continuous until the nebula became transformed into a close system of rings presenting the appearance of a thin plate or disk. The theory would thus fail to account for the formation of the solar system as it actually exists.

2. But even if we adopt Laplace's theory of ring formation, we at once encounter difficulties no less serious. It is obvious, on the slightest examination, that the mutual attraction of different portions of a zone could have very little influence in bringing its molecules together around a common nucleus. Laplace, it is true, supposed the fragments of a ring to have been thus collected into a single planet. "Almost always," he says, "each ring of vapors ought to be divided into several masses, which, being moved with velocities that differ little from each other, should continue to revolve at the same distance from the sun. These masses should assume

* Published at Paris in 1813.

a spheroidal form, with a rotary motion in the direction of that of their revolution, because their inferior particles have a less real velocity than the superior; they have, therefore, constituted so many planets in a state of vapor. But if one of them was sufficiently powerful to unite successively by its attraction all the others about its centre, the ring of vapors would be changed into one sole spheroidal mass, circulating about the sun, with a motion of rotation in the same direction with that of revolution."

In regard to the mutual attraction here referred to, it may be remarked, that two parts of the Neptunian ring on opposite sides of the sun could produce no sensible perturbation of each other's motion. If, moreover, the fragments of any ring were distributed around the orbit with approximate uniformity, their mutually disturbing effects would nearly destroy each other. That this state of things should have obtained in the case of some of the eight principal planets is extremely probable. The theory, therefore, of planetary aggregation by the attraction between different parts of the rings, requires an indefinite antiquity of the solar system. Let us suppose, then, that the planet-forming process was due to the different velocities of the fragments into which a ring had been broken up. Take, for example, the ring which was transformed into Neptune. Let us assume that two fragments, A and B, differed in longitude by 180°, and that the mean distance of the centre of gravity of A from the sun's centre exceeded that of B by 1000 miles. It is then easy to show that the corresponding difference of their angular velocities would not bring them together around the same nucleus in 15 millions of years. But even after *all* the fragments had thus been collected, other millions of years—assuming with Laplace that the united mass was still in the gaseous form—would be required for the process of condensation. The supposition we have made is not an extravagant one. In Laplace's cosmogony, therefore, hundreds of millions of years are involved in the separate history of a single planet. Is so great an implied age of the solar system admissible?

According to Helmholtz, whose theory is now generally accepted, the sun's heat is but the transformed motion of its parts condensed or drawn together by the force of gravitation. Now, the law of the conservation of energy enables us to calculate the age of the sun, knowing (1) the amount of solar heat radiated in a given time, and (2) the amount produced by a given contraction of the sun's mass. It has thus been found that condensation from the distance of the nearest fixed stars to the sun's present volume, would have kept up a supply of heat equal to the present for about twenty millions of years. This estimate, it will be understood, is based on the assumption that the sun's density is uniform from centre to surface. If, as is altogether probable, the density increases towards the centre, the age of the sun may be considerably greater.*

* "On the only hypothesis science will now allow us to make respecting the source of the solar heat, the earth was, twenty millions of years ago, enveloped in the fiery amosphere of the sun."—*Prof. Simon Newcomb in the N. A. Review, for July*, 1876.

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3. The difficulty here presented is one of no small importance. If removed, however, we are immediately met by another perhaps still more formidable. Assuming the increase of Neptune's radius to have been uniform during the time required for the accumulation of the ring around a single nucleus, the daily superficial deposit would be less than one-sixtieth of an inch; the density being equal to the present density of the planet. This extremely slow transformation of the nebulous zones would develop little heat; so that the planets would be nearly cold during the process of their formation. Laplace's theory, therefore, obviously fails to account for the origin of satellites.

4. It is easy to show that the period of a rotating nebula in the process of condensation would vary as the square of the radius. If the solar nebula, therefore, rotated once in 164.6 years when it filled the orbit of Neptune, its period when it had contracted to the orbit of Uranus ought to have been 67 years; at the orbit of Saturn, 16.7 years; at that of Jupiter, 4.94 years, &c., &c. This obvious inconsistency with Kepler's third law* has been noticed by astronomers, and recourse has been had to the additional supposition that the rate of variation of density from surface to centre was continually changing through all the cycles of planetary formation.† Till this latter hypothesis—invented to sustain the hypothesis of Laplace—shall itself have been placed on a basis of facts, the superstructure must be regarded as eminently unstable.

Conclusion.

It has been shown (1) that the hypothesis of Laplace gives no explanation of the immense intervals between the planetary orbits; (2) that, apart from this objection, the periods required for the formation of planets from nebulous rings are greater than the probable age of the solar system; (3) that it fails to account for the origin of satellites; and (4) that it is apparently incompatible with a known physical law. The conclusion seems inevitable that this celebrated hypothesis must yet be abandoned, or that its principal features must be essentially modified.

* Let r, r', and t, t' represent the radii and periods of rotation of the solar nebula at two different epochs; then $t : t' :: r^2 : r'^2$. But by Kepler's third law, $t : t' :: r^{\frac{3}{2}} : r'^{\frac{3}{2}}$.

† See the able and interesting memoir on the Nebular Hypothesis by Prof. David Trowbridge, in the Am. Journal of Science for Nov., 1864.

Additional Notes upon the Collection of Coins and Medals now upon Exhibition at the Pennsylvania Museum and School of Industrial Art, Memorial Hall, Fairmount Park, Philadelphia. By Henry Phillips, Jr., A.M.

(*Read before the American Philosophical Society, October 3d, 1879.*)

Since the notes I had the honor of presenting to our Society last February there have been so many additions to this collection that a further description may be of interest.

Recurring to the arrangement originally projected, the first head to which I would call the attention of the Society is that of Medals.

The medal issued to commemorate the 21st anniversary of the foundation of the Numismatic and Antiquarian Society of Philadelphia (January 1, 1879), and the twelfth presidential term of the Hon. Eli K. Price, has been placed in the medal case, and likewise the full materials for exhibiting its process of manufacture. First there is the large plaster cast taken from the wax medallion originally modeled from life; this latter being perishable has not been preserved, but the plaster representation exhibits a perfect *fac simile* of the original. Secondly, is the same portrait in plaster reduced by mechanical means to the size it is to occupy on the die. Third is the *hub* upon which the portrait is cut in alto relievo by a machine which reproduces in any desired size the figure which it is to bear, and which is afterwards tempered to hard steel. Fourth, the die which is struck from the hub and shows in intaglio the portrait intended to be impressed upon the medal. It is at first soft, so as to easily receive the impression, and it is then afterwards hardened so as to bear the necessary amount of pressure and blows. There are also leaden trial impressions of the dies. These show the whole process of making the dies.

The medal bears upon its obverse the portrait of the venerable gentleman in whose honor it was struck, surrounded by the inscription, ELI K. PRICE, PRESIDENT, 1879. On the reverse the seal of the Society and the inscription, THE NUMISMATIC AND ANTIQUARIAN SOCIETY OF PHILADELPHIA, *founded January* 1, 1858. The meaning of the devices on the seal are as follows:

The owl, which is the crest, symbolizes wisdom and learning; it is taken from the device upon the coins of Athens, issued in the fifth century before the present era, and is a faithful copy of that archaic work of art.

The shield, upon which the quarterings are displayed, is the *Saxon* shield, emblematic of English ancestry and associations; the emblems on each of the four portions of the shield represent, respectively, Europe, Asia, Africa, and America.

Europe presents the cross as found upon the coinage of the first Christian kings of England; Africa, the Egyptian sphynx; Asia, a Chinese coin, and America, the stone arrow-heads, axes and implements of the Aborigines. The motto *vestigia rerum sequi* refers to the nature of the Society's occupations.

There is also a medal (in bronze) of the late Joseph J. Mickley, the first President of the Numismatic and Antiquarian Society of Philadelphia.

This medal was cut by Mrs. Lea Ahlborn, of Stockholm, medalist and designer of the Royal Swedish Mint. The execution of the flesh is remarkably well done, and the whole medal is a credit to the skill of the female artist.

There are also medals of Lavater, Cervantes, Shakspeare, of the *Series Numismatica*, and of Alexander the First of Russia, and Louis XVI. of France, deposited by H. Dumont Wagner, Esq., of this city.

A bronze medal commemorating the Massacre of St. Bartholomew bears on the obverse the head of Pope Gregory XIII.; on the reverse an angel armed with sword and cross destroying and putting to flight a multitude, with the inscription HUGENOTORUM STRAGES.

It may be observed in regard to this medal that doubts have been cast as to whether it was actually issued by the Papal authorities, but rather that it was done by those inimical to the Church of Rome, in order to cast discredit upon it by appearing to exult over such a scene of carnage. The present medal, however, is of most undoubted genuineness, having been purchased in Rome with the whole series of the Pontifical Medals direct from the Director of the Papal Mint. The author of "La Science des Medailles" (Paris, 1715), says, *il ne faut pas confondre avec les veritables medailles des Papes, certaines que les ennemis du Saint Siege ont fabriquées pour les insulter, ou pour les rendre odieux. Telle est celle du Jules III. avec cette inscription qui lui sert de revers,* GENS ET REGNUM QUOD NON SERVIERIT TIBI PERIBIT. *Telle est la Medaille de Paul III,*

ΦΕΡΝΗ ΖΗΝΟΣ ΕΥΡΑΙΝΕΙ,

que l'on ne doit jamais placer parmi les medailles veritables. (No. 52 in the Hockley collection.)

Pinkerton, however, is of the opinion that this latter described medal is genuine and was cut by Michael Angelo. It is certainly a handsome piece of workmanship and would do no discredit even to that great artist if the attribution be correct.

All the medals before Paul the Second, according to the same author, were issued during the Pontificate of Alexander the Seventh. It is stated that the Abbé Bizot had the design of issuing a full line of all the Popes, which he was prevented from accomplishing by the death of the reigning pontiff under whose auspices the undertaking had been begun.

Pinkerton states that the medal of Julius the Second, "*contra stimulum ne calcitras,*" is the first medal which was struck instead of being cast. He attributes to Cellini the medal of Clement the Seventh, "*ut bibat populus*;" that of Gregory XIII. upon the reformation of the Calendar to Parmegiano and to Bassiano and Cavino (the celebrated Paduan forgers) the dies of the medals of Julius the Third.

Mrs. Henry Bohlen of this city has deposited a number of interesting gold and silver coins and medals, among which latter are the following:

A very large silver medal (size 42 of the scale of the Numismatic and Antiquarian Society of Philadelphia), bearing on the obverse a view of the city of Amsterdam; in the foreground the river Amstel filled with vessels

containing armed men. Above the city and below a shield charged with its coat of arms a hand appears holding a heart, projecting from a cloud and surrounded by luminous rays. The inscription consists of these Hollandish verses:

ONS HERT EN HANDT
IS VOOR HET LANDT.

On the reverse a garland of olives encloses the words GODT HEEFT ONS BEWAERT.

Around the wreath is the inscription, ZYN HOOGHEYT WILLEM PRINS VAN ORANGE HEEFT DE STADT AMSTERDAM BELEZGERT DEN 30 JULY ENDE WEDEROM AFGETROCKEN DEN 4 AUGUSTY, 1650.

This medal appears to have been chased entirely by hand, and not to have been struck from a die. Dissensions arose among the States comprising the Dutch Federation during the early summer of 1650, and the Prince of Orange after endeavoring to procure a peaceable settlement of the existing difficulties resolved to obtain justice by force of arms. To this end he sent a secret order to the troops in garrison at Nimeguen, Arnheim and elsewhere to march against Amsterdam, rendezvousing there on the 30th day of June, at an early hour of the morning to force the sturdy burghers into submission. The Prince joined the army, after arresting treacherously six of the prominent men of Horn, Delft, Dort and Harlem, and proceeded in his enterprise, which, however, failed of success, the citizens of Amsterdam having received timely warning. They had placed themselves in a condition of defense, and were prepared to open the sluices and dykes in order if necessary to flood the country, and render it uninhabitable for an army.

The Prince seeing that he could not capture the city had recourse to negotiations, the result of which was that after an agreement had with the Burghers he withdrew his troops from before the city on the 4th of August, 1650.

The present medal is one of a series struck to commemorate this occurrence. (Van Loon Vol. II. p. 329 et seq.)

A beautiful silver medal bearing on the obverse a Janus bust on a pedestal, female head facing left, male head facing right. Above is the inscription,

VERGANGENHEIT, GEGENWART, ZUKUNFT,

AUS ALLEN SCHOEPFE DIR FREUDEN.

Reverse. Upon a band in centre extending from side to side of the medal is the sign of Aquarius, between Capricornus and Pisces. Above is the sun in full glory, sending down beams which fill the whole field and penetrate a cloud which is below the band referred to.

A grand silver medal commemorates the repulse of the Turks before the City of Zenta on the Theiss.

Obverse. A river god standing holding on his left hand a victory which

is offering him a crown. In his right an urn from which a river is flowing. Under his left arm is a tablet with the inscription,

AUSPICIIS
LEOPOLDI MAGNI
VIRTUTE EUGENII
SABAVDIÆ D.
EXERCIT. TURCIC.
CLADE XX. HOST.
FACTA
PRIMARIIS DUCIB.
DELETIS
CASTRIS UNIVERS.
TORMENT. XCVIII.
OMNIQUE APPARATU
BELLICO
INTERCEPTIS.
CÆSUS PROFLIGAT
D. 11/21 SEPT
A° MDCXCVII

Reverse. A besieged city, in the background a river and bridge and mountains; over the town the word ZENTA. In the foreground, cannon, horsemen, infantry, camp, &c. Above is the inscription, INTERFECIT EXERCITUM EORUM ET SUBVERTIT ROTAS CURRUUM FEREBANTURQUE IN PROFUNDUM EXOD. 14.

On the edge in raised letters is the Chronogram, *En novvs ex voto fe*LIX *Leopo*LDe *tr*IVM*phvs*., making the date 1697.

A silver medal shows on obverse a winged female figure standing by a monument overhung with floral wreaths and on whose summit is a casket of flowers, and around whose base plants and flowers are growing. Inscription, DEIN SCHUTZ GEIST KRÆNZE DEINE TAGE.

Reverse. A branch with flowers horizontally across the field and dividing the inscription, MIT FREUNDSCHAFT LIEB UND FREUDE STETS

—(branch)—

WUNSCH AUS REINEM HERZEN GLÜCK.

There is a noble medal in gold with a clasp, evidently to be worn as a decoration, of Frederick III of Denmark and Sofia Amalia, his Queen, in commemoration of the courageous defence of Copenhagen against the Swedes under Charles Gustavus in 1658.

Obverse. A finely executed male laureated bust in high relief. Inscription, DOMINUS PROVIDEBIT.

Reverse. A laureated female bust with the inscription, SPES MEA IN DEO.

The peace of Rodschild (Feb., 1658) had scarcely been concluded, when Charles Gustavus, of Sweden, formed the design of conquering the whole

kingdom of Denmark, and, under the pretext that the stipulations of the treaty were not being carried out, in the month of August he unexpectedly blockaded the roadstead of Copenhagen. All was consternation, and the courtiers begged the King, Frederic the Third, to take to flight for safety into Norway. But his noble spirit revolted, and with Roman bravery he resolved to defend his capital to the last gasp, gave his personal superintendence to all the necessary preparations for its defence, planted the Royal Standard on the ramparts, armed the citizens, assigned to his officers the command of different portions of the city, and, animated by the hopes and promises of succor held out to him by the Netherlandish provinces, whose interests were in common with those of his kingdom, he resolved to perish beneath the ruins of Copenhagen, with his whole family and court, rather than fly or fall into the hands of his enemies. Nor were his hopes unfounded. When the States of Holland knew the design of the King of Sweden to be the conquest of Denmark so as to fall upon the Elector of Brandenburg and be avenged upon him for his having deserted the Swedish cause, and saw that his efforts were to obtain the complete control of the Baltic Sea, to the exclusion of their commerce, they resolved to send a fleet and an army to the relief of the threatened nation, although by some it was argued that to do so might imperil their relations with France and England, which were supposed to be favorable to the Swedish pretensions. On the 17th of October, Admiral Obdam set sail to succor the King of Denmark, who was continuing to defend his capital, with valor and fortitude, although the enemy had became masters of the Castles of Cronenbourg and Helsinbourg, and held the mouth of the Sund blockaded by their vessels, so that the Hollandish fleet in order to bring relief to the besieged would be obliged to run the gauntlet of the fires of these two fortresses, and at the same time manœuvre their ships in a narrow passage to avoid the dangers of an intricate navigation. On the 8th of November the Admiral divided his fleet into three squadrons and proceeded to engage the enemy's vessels, manned chiefly by Scotch and Irish sailors, and commanded by the illustrious Wrangel, as Captain General of the Kingdom of Sweden. About 9 o'clock in the forenoon the combat began, and raged for six hours with great fury in the presence of the King of Sweden himself, who in company with his wife and sister and other personages of high rank watched from the Castle of Cronenbourg the fortunes of the fight. The Swedes fought bravely as ever, but the extraordinary valor of the Hollanders was ultimately crowned with success. Of the enemy's vessels they captured three, and burned and sunk eight others, forcing the rest to take to flight, thus permitting a juncture to be made with the the Danish flotilla under Admiral Bielke. The Sound was opened by valor and force of arms, and the Swedes chased out of that sea by a most glorious victory, whose memory was preserved in this and some other medals.

A silver medal presents on the obverse Neptune boldly engraved standing in a chariot drawn by two horses upon a stormy ocean whose waves are lashed into fury by Æolus in the right corner. In Neptune's left hand is

his trident upright, his right is extended open pointing right. Upon the seat of the car is a crown. Inscription, MOTOS. PRÆSTAT. COMPONERE. FLUCTUS.

Reverse. Upon a calm and stilly sea is floating a nest in which are two halcyons. On the right the setting sun is illumining by his rays the whole field of the medal. Above on a band is the inscription. HALCIONIBUS. REDUCTIS. SENATUS. AMSTELOD. CIVIBUS. SUIS. HOC ANTIQUÆ. VIRTUTIS SPECTATÆQ. FIDEI PRÆMIUM. LARGITUR.

In the exergue, MDCXCVI. (Vide Van Loon, Vol. 4, p. 221.)

It would be hardly credible what a tumult could always be started in the Netherlands from the most trivial causes were not history so very explicit. The present medal was struck to commemorate a sedition which grew out of an ordinance regulating the number and the salaries of the criers at the public funerals. Those who were excluded from this employment felt at one blow their whole subsistence taken away from them; were full of discontent and clamored loudly against the magistracy, alleging that their offices had been wrested from them in order that the underlings and parasites of their rulers might be provided for comfortably. To further augment the popular feeling it was given out that the bodies of the poor were mutilated by branding previous to interment. The people became inflamed and maltreated the new criers wherever they met them, till at last, emboldened by the usual applause and serenity of the bystanders, on the night of the 30th of January, the day preceding that on which the new regulation was to go into operation, they assembled in great numbers on the *Dam*, a public place in front of the Hotel de Ville. The troops were called out but their presence only served to increase the tumult while the populace, armed with stout cudgels, formed themselves regularly into companies, rallying under aprons of blue cloth and beating for drums upon empty beer barrels.

The mob continued to grow and traversed the streets like madmen, followed by a troop of children. Arrived at the *Aelmoesseniers Huis* they put to flight the soldiers placed there as a guard to the syndics of the criers of funerals, and fired by their exploit, in thus having overturned constituted authority, they turned to pillage the houses of obnoxious officials. The Burgers were called to arms, now realizing that the rioters intended to sack the city if possible, using their grievance merely as a stalking horse. Night fell upon the scene, but in the early morning before the citizens had assembled to take arms, the rabble came together again and after pillaging with renewed fury laid siege to the house of Burgomaster De Vries. The Magistracy now issued an order declaring that force must be resisted by force; the citizens assembled and marched towards the field of battle, fired upon the riotous assembly, killed two and put the others to flight. Whilst this was taking place a portion of the mob engaged in sacking the house of a rich Jew named Pinto (and could there ever be popular uprising in Europe without a Jew's house being pillaged?) was fallen upon by another detachment of the citizens who drove them away at the point of the sword. The bridges

were all raised, and the gatherings in other quarters dispersed by a summary administration of justice.

Two of the robbers taken in the field were hung to the neighboring lamp-post, and a strong force was posted on the Dam and other exposed parts of the city. At the first news of the insurrection the regiment of Guards, which was stationed at 'S Gravemoer, had taken up its march toward the city to assist, if needed, in quelling the disturbance, but when distant only two leagues from Amsterdam, the Council did not judge it expedient to receive the troops, but thanking them heartily for their zeal, begged them to hold their present position unless it should so happen that the riot could not be put down by the fidelity and the valor of the citizens. Volunteers under the command of Messrs. Hinlopen, Six, Burg and Huydekooper, patrolled the streets to preserve order until the fourth of February. On the 6th, six of the rioters were executed, and the corpses of four others, who had been killed in the tumult, were hung up by the feet on the same gallows. Several of the survivors were shut up in the House of Correction.

The Magistracy sensible of the zeal and courage of the train bands and of the volunteers, and desiring to exhibit in an honorable way the gratitude of the citizens, caused the present medal to be engraved in three different sizes, which, on the 28th of November of the same year, were distributed publicly to all the troops, each man receiving a different size according to his rank.

A silver medal bears upon the obverse a widow seated between two children in a cemetery, pointing to the all-seeing eye in the heavens in a triangle surrounded by rays from which an angel is descending and emptying upon their heads the contents of a cornucopia. On the left is an obelisk (upon which is engraved the letter C), surrounded by English yew-trees. Above, on a ribband, is the inscription, HY IS DER WEEZEN VADER. In the exergue, TER GEDACHTENIS AAN DE *weezen uit gedeeld.*

The reverse exhibits three sides of a building enclosing a court-yard; above is the inscription, LUTH. DIAC. WEESHUIS. In the exergue, *gesticht* MDCLXXVIII. *Jubile gevierd* 24 *Aug.* 1778.

A bronze medal commemorates an Industrial Exposition, held at Berlin, in 1844. Obverse, Germania seated upon a rock holding a wreath in right hand, a sword partially drawn from its scabbard reposing on her lap. Her left hand rests on the rock which bears the inscription, *Seid einig.* Exergue, GERMANIA. Inscription, ERINNERUNG AN DIE AUSTELLUNG DEUTSCHER GEWERBSERZEUGNISSE ZU BERLIN, 1844. Reverse, a locomotive crossing a bridge. Around this is a wreath on which are five shields with emblems respectively representing navigation, manufactures, mining, philosophy and agriculture. Inscription, VORWAERTS MIT DEUTSCHEN FLEISSE UND DEUTSCHER KRAFT.

A bronze medal represents on the obverse a King standing by a throne, with his right hand extended in the act of swearing, between two female figures. The one on the left holds a tablet on which is inscribed GROND

WET; that on the right, a spear. Inscription, NEDERLAND 12 MEI 1849; exergue, *Je maintiendrai.*

Reverse, a female uncovering a male portrait before a throne, and a kneeling female inscribes upon tablet XXV JAAR. Inscription, NEDERLAND 12 MEI 1874; exergue, *Jubilæum.*

A fine bronze medal exhibits a beautiful laureated head of Napoleon within a wreath tied with ribbands on which are inscribed, *Wagram, Tivoli, Pyramids, Marengo, Luneville, Amiens, Codes, Lejion d'honneur, Austerlitz, Jena, Tilsit, Simplon.*

Reverse, a view of the Island of St. Helena, with ships in the foreground, setting sun to right, eagle on branch in air. Inscription, IL MOURUT SUR UN ROCHER. Exergue, *Ile Ste Helene. 5 Mai* 1821.

A gilt medal bears on obverse, a male bust in costume of the fourteenth century and inscription, JOAN GALEATIUS VICE COM. A FUNDAMENTIS INCHOAVIT AN. MCCCLXXXVI.

Reverse, the Cathedral at Milan with the inscription, LATUS, ECCL. METROP. MEDIOLANI.

A bronze medal bears on the obverse a Cathedral with date in exergue, 1342–1516. Inscription, DER VÄTER FROMMER SINN RIEF DICH INS LEBEN. Reverse, the rear of the same building in a ruined, incomplete condition; in exergue, *zerstört am 7 Mai* 1842. Inscription, VEREINTE KRAFT WIRD WÜRDIG DICH ERHEBEN.

A white metal medal, on obverse an unfinished Cathedral with date in exergue, 1242. Inscription, as follows:

DAS ALTE CÖLN HAT EINST GEGRÜNDET
DIES WUNDERVOLLE GOTTESHAUS;

Reverse, the same finished with inscription,

DOCH DEUTSCHLAND HAT SICH JETZT VERBÜNDET
UND BAUT MIT GOTTES HÜLF' ES AUS.

Exergue, the date 1842.

Mr. Isaac F. Wood, of New York city, has presented to the Numismatic and Antiquarian Society of Philadelphia, a number of medals in white metal and copper, issued by himself commemorative of various events, and which have been placed in the exhibition. One of Haverford College (Series B. No. 2), bears on the obverse a well executed head of William Penn, with an inscription, and on the reverse a view of the college building. Another bears on the obverse the head of Washington in a keystone with dates 1732-1799; on the reverse, the inscription, "Washington, fit keystone in the triumphal arch which spans the nation's century."

Another (Series C, No. 4), has on the obverse the head of Washington surrounded by the inscription, "The lover of peace he espoused the sword for the colonies' birthright. 1775—100 years—1875;" reverse, a representation of a house and trees with inscription, "The Washington Elm, Cambridge, Massachusetts; June 3d, 1875. Centennial Celebration."

Another bears the head of Washington with the inscription, "True, and

wise, and merciful and just. 1732–99 ;" on the reverse, a representation of Washington's tomb with the inscription, "Mount Vernon Chapter, No. 228, R.·.A.·.M.·. Mnt. Vernon, N. Y. ' Another struck to commemorate the dedication of St. Patrick's Cathedral, New York city, by Cardinal McCloskey, on the 25th day of May, 1879, bears on the obverse a representation of that building, and on the reverse an inscription setting forth the event for which it was issued.

Another bears on its obverse a representation of "Founder's Hall," Haverford College, and on the reverse a chapel, with the inscription, "Alumni Association of Haverford College, Pennsylvania."

A bronzed medal. Obverse, the head of Major Andrè, with the inscription, MAJ. JOHN ANDRE, OCTOBER 1, 1780. Reverse, a church, with the inscription, OLD DUTCH CHURCH, TAPPAN, WHERE MAJ. ANDRE WAS TRIED.

A bronzed medal. Obverse, head of Washington, "HISTORICAL AND FORESTRY SOCIETY OF ROCKLAND COUNTY, ORGANIZED FEB. 22, 1878. Reverse, a farmhouse, "WASHINGTON'S HEADQUARTERS, 1780, TAPPAN. ERECTED 1700."

A bronzed medal. Obverse, bust of General Wayne, CENTENNIAL ANNIVERSARY OF THE BATTLE OF STONY POINT, JULY 16, 1879. Reverse, an army besieging a fortress across a river and on a bluff. STONY POINT EXPUGNATUM, XV JULY, MDCCLXXIX.

Among the series of copper Dutch medalets, which are on exhibition in the first medal case, the following are of the most interest :

No. 34141, bears on its obverse upon a sea violently in commotion, lashed by storms, a ship whose topmasts have been broken off, above which is the date 1565. Inscription, INCERTUM . QUO . FATA . FERENT. On the reverse, a female figure holding her right hand towards heaven, and in her left an anchor ; from above rays are streaming down upon her head. Inscription, SPES . ALMA . SUPERSIT.

This jetton was struck in reference to the dissensions and lack of unity then prevalent in the Netherlands and the unfavorable outlook of the times.

No. 34179 has on the obverse the inscription, LAPIS . REIECTUS—CAPUT . ANGULI. Within a circle of very fine lines a three-cornered stone, showing its broadest part downwards ; below is a crowned lion with a shield near the inscription on the border. Reverse, DNS. FECIT. HOC. ET. FU. (it) MI. (rabile) IN OC. (ulis) H. (ominum.) 1574. The sacred name of Jehovah in Hebrew letters within a circle, beneath which are clouds, whence beams and rays are spreading downwards.

No. 34214. Obverse, AFFLICTOS . DOCET . VIAM . SUAM. 1577, and a five-leaved rose. In the lower foreground is the figure of a man resting upon the earth (the prophet Elijah), receiving in his right hand a piece of bread, which a hand is reaching to him from out of the clouds. In the background of the landscape appears a city. In the clouds the name of Jehovah in Hebrew letters. Reverse, LIBRAT . A . CONDEMNANTIBUS . ANIMAM . EJUS. Daniel in the lion's den by the side of two lions. Above

the name of Jehovah in a cloud (as on the obverse), and a hand stretched out. This piece refers to the gloomy state of affairs and is intended to recall to the mind of the distressed or doubting Hollanders the two signal examples of the Divine beneficence that are commemorated upon this coin.

No. 34379. Obverse, ZELUS . DOMINI . EXERCITUUM . FECIT . HOC. Upon the upper portion of the field the name of Jehovah in Hebrew letters, surrounded by a cloud from which a naked arm holding a sceptre is projecting; below is a landscape in which several cities and towns are visible. Reverse, STENOVICO. | OTMARSIA. | COVORDIA. | CAPTIS. | HOSTE. | REPULSO. | SEN. | FŒD. PRO. | F. | F. | M·D·XCII. This piece refers to the capture of the cities named.

No. 34404. Obverse, CASTRACON | SPEXIT INSE | ADVERSARIA | SELVOLDA CUM | BISLECHIO AD | NOV' MDXCV. Reverse, a battlemented tower, at whose base a battering ram worked by eight warriors is being operated and has effected a breach. This and the next jetton commemorate the capture of the towns of Selvold and Bislich.

No. 34405. Obverse, QUÆRERE. Within a circle of vines Mars stands armed with lance and shield; by his side the trunk of a tree, upon which a bird is resting; in the foreground a mass of infantry. Reverse, ET. TUERI. MDXCV. A female figure seated facing front, with a large helmet upon her head, holding in her right hand a shield, upon which is displayed the Lion of Holland; in the left a lance; at her right side is seated an owl upon a branch. In the background is an encampment of tents. This relates to Prince Maurice's prudence in preserving his conquests and to his Mars-like valor in effecting them.

No. 34407. Obverse, FRUSTRA . OPPUGNAT . USQUEDUM . PROTEGIT . DEUS. Soldiers standing by a river bank with a crowned leader; the other side of the river is protected by a shield which a hand holds out from heaven. Under the shield are four soldiers ready for the fray, and behind them are seen kneeling three persons in prayer. Reverse, VIGILATE . ET . ORATE . DEO . CONFIDENTES . MDXCVI. A seated female figure with folded hands; upon her right a sentry is keeping watch; on her left a shield displaying a crowned lion, by the side of which is a tower, upon whose summit there is also a sentinel.

This jetton refers to the province of Zeeland being threatened by the Archduke Albert.

No. 34423. Obverse, ORDIN. | AUSPIC. PRIN. | MAURI. DUCTU. | HOSTE AD TUM | NOUTUM CÆSO. | DECEM OPIDIS. ET. | TRIBUS. ARCIBUS. | EXPUG. ET. TOTA. | CISRHE. DITIO | NE. PACATA. | 1597. Reverse, SOLI. DEO. HONOR ET GLORIA. The Belgian lion rampant, holding a sword and bundle of arrows. This celebrates the victory at Turnhout and the recapture of nine towns.

No. 34457. Obverse, IMPERATOR. MARIS. TERRÆ DOMINUS. A full-rigged ship under sail. Reverse, LUCTOR ET EMERGO. 1602. A four-leaved rose between small crosses. This relates to commerce and navigation once more beginning to be lively.

No. 34461. Obverse, ARS. GRAVE. TOLLIT. ONUS. A man bending down over a lever is endeavoring by its means to raise a huge millstone. Reverse, INDUSTRIA ET LABORE. A spade transpiercing a crown. In the exergue MDCII.

This relates to the surrender of Grabe.

No. 34491. Obverse, SERVAT. VIGILANTIA. CONCORS. MDCVI. A ship in a storm-tossed ocean, whose waves are breaking its masts; clouds are in the heavens. Seven figures are to be seen upon the ship who are busied in taking necessary measures for the preservation of the ship and bringing it to its destination. Reverse, MODICÆ. | FIDEI. QUID. | TIMETIS. | S. C.

This refers to the general depression and consternation of the Netherlanders.

No. 34518. Obverse, FORTITUDO . BELGICA. A bundle of arrows with their points upwards. Reverse, MDCXII. | INDUCIAR. | IIII. | S. C. | This commemorates the fourth year of the truce.

2ND. COINS.

Among the coins a number of fine specimens have been added, of which the following are a few of the more important.

There is a very interesting silver coin of ancient Spain. It bears on the obverse a head with a stern forbidding countenance, and crisp curled hair and beard, calling to mind the conventional Assyrian type. There are also certain rude letters both on the obverse and on the reverse. It is the current opinion among Numismatists that these coins were copied after those issued by the early Greek monarchs with such changes as the lack of skill on the part of the artists would naturally cause. The reverse exhibits a horseman charging with a lance seated upon a steed whose forefeet are raised in motion from the ground. The action is spirited, and by no means so stiff as the low state of the arts would have warranted us in expecting. The head on the obverse does not, in my opinion, bear out its presumed Greek origin, and I incline to the belief that it is rather a representation of some one of their gods, possibly the Phœnician Hercules.

The first settlements in Spain were those of the Carthagenians, established ages before the earliest known periods of classical history.

There exist numerous varieties of these early Spanish coins with various inscriptions, which have only been deciphered in the last few generations, and even as yet their true signification is in doubt. The author of *La science des Medailles*, an early work on Numismatics, published at Paris in 1715, speaks of these coins as being truly *medallas desconnocidas*, which no one had undertaken to collect or reduce into order, although "Lastanosa *ait crû rendre un grand service aux curieux, de se donner la peine d'en faire un Volume, qui fut imprimé a Huesca en* 1645 *ou il a fait graver environ deux cents de ces medailles qu'il avait dans son Cabinet, la plûpart d'argent.*"

Lastanosa had an insight into the true status of these coins which had been considered as bearing Punic letters. He maintained that the characters on them were those of the early language of Spain, and that it was

to these coins Pliny referred when speaking of the booty carried away by the Romans from Spain, *argentum signatum oscense.*

The coin of which we are speaking has been ascribed by both Henin and Akerman to the city of Tarragon, the capital of the Province of the same name, much celebrated in ancient authors for its beauty and opulence. Pliny writes of it that it was *Scipiorum opus ut Carthago Pœnorum.* Augustus erected in honor of his visit, an altar, upon which subsequently a palm-tree grew. It issued coins while under the dominion of the Romans, and there are some extant bearing the heads of the Gothic rulers of Spain.

Carthage is probably one of the best known cities of antiquity, and abundant specimens of its coinage have descended to our own times. The pieces in the exhibition are small bronze coins bearing on the obverse the head of Demeter (or Persephone) adorned with necklace, earrings, &c., and on the reverse the figure of a horse and a palm-tree.

The Carthaginians adopted from Sicily the worship of Demeter and Persephone, and the horse possibly refers to Libya, which was famous for its horses, or perhaps to the horse's head fabled to have been dug up at the foundation of the city. Carthage was ultimately destroyed by the Romans 146 B. C., and the coin was probably issued about the third century before the present era.

There is a very fine didrachm of VELIA in Lucania bearing on the obverse a beautifully executed head of Apollo, and on the reverse a lion in the act of leaping upon a stag, which it is rending to pieces. The muscles are admirably portrayed, and the action is depicted entirely without stiffness, but with the ease and grace which arises from the consciousness of power and strength.

Velia was a large and prosperous city founded by the Greeks, and its coinage exhibits the undoubted confirmation of history. Greek culture alone could have produced such fine specimens of Art It is now known as *Castela mar della Brucca,* and lies between Policastro and the Gulf of Salerno. It was mentioned by both Strabo and Pliny, and was the seat of the Eleatic sect of Philosophers, who received their appellation from the city; their leaders were Zenophanes, Parmenides, Zeno and Melissus. The speculations of this school rose to a higher region of pure thought than those of the Ionic or Pythagoric schools, and among the Eleatics for the first time comes distinctly into play the dialectical movement in human thought.

Corinth, in Achaia, is represented by a fine didrachm, bearing on the obverse helmeted head of Venus; and on the reverse, Pegasus, with the letter ♀ (Koph), the ancient or Phœnician form of K. "A city," says Strabo, "large, rich and prosperous; replete with men fit for the handling of every sort of affair, civil, artistic and political." Founded by Bellerophon, the type of the reverse refers to his subjugation of the steed Pegasus.

The coinage of this city exhibits a high degree of artistic culture, a thorough proof, were any wanting, of the truths which history records of

its refinement and luxury. From the earliest days of its coinage, when the reverse was simply the rude punch mark, to the last periods when its money was issued, the pieces struck and engraved for this city are worthy of a high rank and possess a great merit.

The very first coins issued by Corinth bear on the obverse Pegasus, with the archaic letter ♀ (Koph), which disappeared from the later Greek alphabet. Reverse, the so called key pattern punch mark. The execution of the flying horse is very bold.

This city was colonized at a very early period by the Phœnicians, and was destroyed by the Romans under L. Memmius, B. C. 146. The present piece was issued about 480 B. C.

It is interesting to compare the coinage of this city with that of Sybaris, both of infamous renown for the pursuit of pleasure.

There are also specimens of what is known as the *incused coinage* of Magna Græcia. These pieces were issued by the Grecian colonies settled in lower Italy, and are probably the most remarkable specimens of the monetary art which have ever been produced. Instead of being thick and hemispherically raised towards the center, they are thin and flat, and bear on the reverse in intaglio the same subject which the obverse bears in alto-relievo. This coinage had been abandoned before the sixth century B. C., and all these coins are of very great antiquity, yet their workmanship is fine and artistic, even when the design is of the simplest. What the object for the adoption of so peculiar a form could have been, has been the subject of numerous conjectures, but as yet none seem satisfactorily to explain this abnormal condition of coinage.

The specimens which the Numismatic and Antiquarian Society have placed on exhibition are SYBARIS and METAPONTUM.

The coinage of Metapontum bears on the obverse an ear of corn, on the reverse the same incused. This city was founded about 700 B. C., by a colony from Northern Greece, and its prosperity became exceedingly great, owing to the fertility of its soil, which was especially rich in wheat. The Metapontines sent annually to the temple at Delphi a golden sheaf of wheat and considered Ceres as their tutelary goddess, impressing her emblem, the ear of corn, upon their coinage.

Sybaris presents, on the obverse, a bull standing and looking backwards, and the same type incused on the reverse, with the inscription *ΥΜ*, being written from right to left in the most ancient manner and with the *sigma* of an archaic type, resembling a *mu*. The history of Sybaris and its successor city, Thurium, is well told by Dr. Cardwell.

"The peo, le of Sybaris, on the bay of Tarentum were conquered and their city destroyed by the Crotoniats about the year 500 B. C. Fifty eight years afterward the Sybarites endeavored to rebuild their city, but were again driven away six years later by their old enemy. The aid of Athens and the Peloponnese was invoked, which in 444 B. C. laid the foundations of Thurium, near the site of the ancient Sybaris, taking the name from a fountain in its neighborhood. Soon the foreign element prevailed over the

Sybarites and put them to the sword. * * * What then is its numismatic history? We have several coins of Sybaris, bearing in the form of their brief inscriptions and workmanship the strongest evidence of high antiquity, so that we may fairly assign them to a period fully five centuries before the Christian era. The constant device on these coins was *Bos stans et respiciens*, showing that it was the acknowledged cognizance of Sybaris. The next coins belonging to the place are more recent, as we may judge from the form of their letters and their highly finished style of workmanship, and taken on the analogy of coins in general, they might be assigned to a period not much anterior to the time of Philip and Alexander. But we find from these that the devices of the place have undergone an important change. The ancient cognizance of Sybaris is now of secondary consequence and has given way on one face of the coin to the *Caput Palladis*, the well-known badge of Athens. The inscription, too, is, in one instance, the abbreviated word Sybaris, in another a similar abbreviation of the newly contracted name, Thurium. So then, these coins strictly mark the period when the natives and foreigners were living together in compact, mutually endeavoring to conciliate each other, each party preserving tokens of its hereditary attachments.

"The next set of coins is distinguished by a minuteness of ornament which marks them decidedly as the most recent of the three, and these coins, in perfect accordance with the historical narration, bear no memorials of the ancient Sybaris. The inscription in every instance is of Thurium, the *Caput Palladis* is prominent, and the ancient cognizance of the Bull is no longer *stans et respiciens* but *irruens et cornupeta*. Doubtless there was found in the meaning of the word θουρίων, a reason for the difference they adopted 'a bull running and butting.'

"When, later in the history of the town, Athens and other powers of Greece began to claim it as a dependency, they boldly refused to acknowledge any other founder or patron than the deity of Delphi. And what say the coins? Some of them, which seem to have been minted when the republic was yet scarcely free from its ancient habits, retain the badge of Athens, but some also bear the emblems of Ceres, the tokens of agricultural prosperity, and others are impressed with the head and insignia of Apollo."

The device of the bull occurs upon the reverse of a denarius of Augustus (of which a specimen is in the present collection), and also those of the gens THORIA. "The 'Bos irruens,'" says Smyth (Northumberland family coins, p. 238), "or a fierce bull charging, is no doubt a punning allusion to the moneyer's cognomen, θαύρτος, impetuous, and not an agrarian emblem. Some antiquaries, however, insist that it alludes to an agrarian law introduced by the tribune Sp. Thorius Balbus, which lex concerning the Roman public lands was engraved upon the back part of the same tablet which contained the Lex Servilia de Repetundis; this tablet was broken

* Cardwell Lecture, III, p. 66 et seq. Diodorus Siculus, lxi., § 90, &c.; lxii., § 11 and 35.

at some unknown time, but seven of its fragments have been preserved and published by Fulvius Ursinus about A. D 1577."

"The symbol of the bull plays an important part in many mythoses. This animal was intended to represent power of body and unwearied masculine energy, two great attributes especially coveted by ancient kings and great men. The bull seemed to be, in a manner, sacred to Venus, whilst the lion was emblematic of the male creator. The bull and the lion, among the Assyrians, occupied much the same place as the lion and unicorn do in modern heraldry. Lajárd (*Culte de Venus*) has summed up the matter in the following words:

"Les deux principaux attributes characteristiques de Vénus furent en orient comme en occident le taureau et le lion, l'un symbole du principe de la chaleur et du pouvoir generateur actif, l'autre, symbole du principe humide et du pouvoir generatif passif; et tous les deux signes du Zodiaque, mais avec cette difference que le taureau etait le premier signe de l'equinox vernal et la domicile de la lune á l'epoque de sa plus grande exaltation, et que le lion placé au solstice d'été etait le domicile du soleil pendant la canicule. Ces deux animaux furent donc aussi les hieroglyphes ideographique de l'hermaphroditisme de Venus, divinité a laquelle les anciennes traditions assignent, comme a Mithra, une place entre les equinoxes et les solstices et donnent pour monture le taureau." In another passage he writes thus: "Premier être sorti des mains d'un dieu créateur du monde, le taureau, symbole de vie, est appelée d'un nom qui signifie à la fois *vie* et *taureau*. Par une conséquence immédiate d'une doctrine qui enseignait que les premiers êtres vivants étaient né dans l'eau, il est, en même temps, le symbole de principe humide, du pouvoir passif de la génération ou du sexe feminine." (Inman's Ancient Faiths, Vol. 1, p. 376, et seq.)

The symbol of the bull also is frequently taken to represent water, or the watery principle in which life takes its beginning* and hence, no doubt, the reverence paid to rivers, as instanced, even at the present day, in India, by the burial of the Hindoo dead in the holy waters of that region. It may therefore be considered as a representative of the ΚΤΕΙΣ or the great humid principle of nature.

Not a trace now remains of Sybaris, this great city which once ruled over twenty-five of its neighboring towns, and sent into the war that resulted in its downfall three hundred thousand fighting men. Nothing is known of its mansions and its palaces, not one stone is left to show the spot where "men slept upon beds of roses and those renowned banquets took place to which women were bidden a year in advance that they might have the whole interval for rendering their beauty more irresistible." Recent explorations have resulted in the finding of a sarcophagus full of carbonized matter, showing that the corpse had been cremated prior to interment.

Amidst the remains of the funeral pyre, near the head of the corpse, were some golden fragments, the ornamentation of a box, and afterwards the bronze nails with which it had been fastened were found. Near the breast

* cf Inman, p. 377, *note*.

of the deceased were two small silver plates, of the size of large buttons, which bore in relief two beautiful female heads. Near the remains of the skull was discovered a small plate of thin gold folded together, on which were visible some traces of Greek writing, and which, on being opened, disclosed within its folds another similar tablet likewise bearing an inscription. The learned professor to whom this find was given to decipher, believes that the larger plate contains mystic matter written by one familiar with the Eleusinian mysteries; the small plate contains an inscription in capital letters in the Doric dialect, in which a hierophant addresses the dead, congratulating him that after having suffered the worst of evils he had from a miserable mortal become a god, having pursued the right path which leads to the fields reserved for the just in the bowers of Persephone.

There is a fine Tetradrachm of the famous city of Tyre (in Phœnicia), bearing on the obverse a laureated head of Heracles, on the reverse an eagle on rudder behind a palm branch, to left date *HI* (year 18), inscription, *ΤΥΡΟΥ ΙΕΡΑΣ ΚΑΙ ΑΣΥΛΟΥ.*

Tyre was one of the grandest cities of all antiquity, and its commerce and riches are frequently spoken of in the classical writers. From Tyre, as from modern London, ships went to visit all parts of the globe to which they could reach; and to Tyre came merchandise from all parts of the continents of Europe and Asia. According to Herodotus it was founded about 2755 B. C., and received its independence about 126 B. C. This coin was therefore issued about 108 B. C. The execution of this coin is especially noteworthy. The massive boldness of the head of Melkarth (the Tyrian Hercules) exhibits a brutal and repelling countenance; the eagle (sacred to this god) on the reverse is in an attitude of life-likeness almost unsurpassable. The rudder exhibits the maritime character of the city and the palm was the emblem of Tyre and Sidon. Phœnicia is fabled to have taken its name from this tree, which in Greek was known as *ΦΟΙΝΙΞ*. The palm was likewise the well known emblem of victory. As found upon coins it is, according to Spanheim, of three varieties, viz:

1st. That which is tall, thick-branched and leaved, but bears no fruit.

2d. Smaller, less dense and bears fruit.

3d. The small sterile dwarf palm.

The palm tree of Judea, which bears fruit, is found upon the coinage of that country. As a branch the palm is found upon the coins of Arabia; as a tree, upon those of Tyre, Damascus, Alexandria and the Phœnician Colonies of Sicily, Africa and Spain.

The palm tree was one of the ornaments sculptured in Solomon's Temple, and among modern writers (*e. g.*, Inman's Ancient Faiths) has been considered to be a Phallic emblem equivalent to Asshur. "On a coin of Ephesus a palm tree is represented as springing up by the side of a stag cut asunder, meaning that the 'Great God (Kronos or Ilos) being cut off, the palm tree repairs all.'"*

* Inman, Vol. I, p. 193.

The epithets, *ΙΕΡΑΣ* (Holy) and *ΑΣΥΛΟΣ* (inviolable sanctuary) were adopted by many other cities. After a very long period of life, with checkered prosperity, Tyre was finally destroyed by the Saracens, A. D. 1291, after having withstood many sieges, including one by Alexander the Great.

In addition to these already described in my previous paper there are a number of so called family coins, among which are well preserved specimens of the Cornelia, Fulvia, Hostilia, Maiania, Opeimia, Pomponia, Scribonia, Vibia, and other gentes, presenting interesting types. The gens Cornelia was a most noble family, both Patrician and Plebeian, and has left a number of devices upon the denarii which are attributed to it. The gens Fulvia although "confessedly one of the most conspicuous of the Roman gentes, is only known by one denarius, except some colonial ones figured by Morell" (Smyth Family Coins, p. 85). It bears on the obverse the head of Pallas Nikephora with alated helmet and the word ROMA; on the reverse, "Victoria alata holds out a chaplet in a biga galoping to the right. Under the horse is CN FOUL, and in the exergum M GAL Q MET. Although we do not hear of the Fulvii till L. Fulvius became consul in B. C. 322, it is known that even then they were of long standing in Tusculum. * * Of the ladies of this gens two played a very conspicuous part; the first, a woman of rank, divulged the Catalinian conspiracy, the second married Mark Antony for her third husband, breathing nothing but war and domination. This is the fury who pierced the dead Cicero's tongue with a bodkin, uttering all sorts of opprobrious epithets all the while." (Smyth, *loc. cit.*)

A denarius of the gens MAIANIA presents on the obverse "a winged and galeated head of Roma with the mark ×; on the reverse, a winged Victory in a rapid viga holding the reins firmly with her left hand, while her right is whipping the horses, which are unusually free from harness. Below is the inscription C MAIANIA; exergue ROMA. History makes no mention of this gens and its rank is unknown." (Smyth, p. 127.)

The gens OPEIMIA presents "the galeated head of Pallas, bearing stern and manly features, wearing an earring with a long pendant and a necklace; in front is the denarial stamp ×, and at the back is a chaplet. On the reverse, L. OPEIMI; exergue Roma. Victoria alata in a galloping quadriga holds the reins with her left hand and a laurel crown in her right. This was probably struck by L. Opeimius, the aristocratic prætor who suppressed the revolt of Tregellæ, B. C. 125. This is the man who being consul four years later, hunted C. Gracchus, with personal animosity, to his destruction; and being himself condemned for receiving Jugurtha's bribes, died, hated and insulted, a poverty stricken exile at Dyrrachium. * * * The Opeimii are first brought on the stage of history at the time of the Samnite wars, yet the components of the gens are but little known." (Smyth, 157.)

The denarii of the gens Pomponia occur frequently and are of many devices. Upon some are seen the figures of the Muses, Clio, Euterpe, Thalia, Melpomene, Terpsichore, Erato, Polyhymnia, Urania, and Calliope, with

the symbols respectively indicative of their supposed avocations. Upon one denarius is found the representation of Hercules Musagetæ playing upon a lyre. "The temple of Hercules Musarum was built in the Flaminian circus by the consul Fulvius, who having, when imperator in Greece, recognized Hercules as Musagetes, consecrated to his tutelar protection the nine statues of the Muses, which he had brought over from Aetolia, B. C. 189. The Pomponia, though a plebeian gens, were very proud, and, towards the end of the Republic, followed the example of the other Roman gentes by claiming high antiquity, pretending descent from Pompo, one of the sons of Numa." (Smyth, p. 184, et seq.)

The gens Vibia likewise affords many varieties of obverses and reverses. Among the former we find the laureated head of Apollo, the head of Pallas, an ivy crowned head of Bacchus, a scenic mask of Pan, a laureated female head supposed to represent the Goddess Libertas, laureated head of Hercules, bearded head of Jove; on the reverses are galeated figures in quadriga, Ceres crowned with wheat marching across a field, Jupiter Axuris, Roma seated on a pile of bucklers, holding in her right hand a spear, in her left the parazonium, pressing with her left foot on a globe, and in the act of being crowned by a flying Victory, two clasped right hands sustaining a winged caduceus (relating to D. Brutus, who being besieged by Mark Antony at Mutina, B. C. 45, was liberated by the consuls Hirtius and Pansa), a panther with his fore feet raised on a decorated cylindrical altar on which are the Bacchic attributes, a bearded mask and a long thyrsus adorned with ribbons, Victoria alata placing a garland upon a trophy composed of spoils, and Ceres, crowned with corn, holding a lighted torch, seated in a car drawn by two dragons." These dragons are portentous creations of the ancient imagination in all countries. The serpent worship was all but universal. It is alluded to in the earlier portions of the Bible, and it is known to have prevailed among the Chaldees, the Persians and the Egyptians as emblematic of the Sun and Time and Eternity. From the Orientals it descended to the Greeks, and from them to the Romans, among whom it became a type of Victory, Prosperity and Health." (Smyth, p. 255, et seq.) Ceres in her car, drawn by dragons, likewise occurs upon the coins of the gens Volteia.

There is a handsomely executed Paduan fabrication of a first brass of the Emperor Otho, bearing his head on the obverse, and on the reverse the Emperor standing with his right hand extended over an altar clasping the hands of three soldiers who bear military ensigns; inscription SECURITAS P. R. S. C. A Roman first brass of the Emperor Otho is something that has always been a desideratum; none are known to exist or to have ever existed. Bronzes from the Egyptian Mint are to be met with and these alone must replace the Roman issue in collections unless the unexpected, which is always occurring, should some day bring to light a hoard of these coins. The usual explanation given for the absence of the first bronzes of this Emperor is based upon the power retained by the Senate of striking copper, while their rulers had usurped the privilege of coining gold

and silver. The denarii of Otho are of not infrequent occurrence, notwithstanding the extremely short duration of his reign.

We cannot more appropriately conclude this sketch than with the words of the Spanish writer, Gussême:

"*No pretendo que la aficion á las medallas sea la única; pero sí que no se olvide, que no se abandone, antes sí que se cultive. Ella es de tal calidad, que siempre recrea, que ofrece a cada paso nuevas satisfacciones, y con una solidez, que no se halla con tanta freqüencia en los demas estudios.* * * *La Erudicion debe ser en todos tiempos, y en todas Naciones apetecida y solicitada; y seguramente no hay modo para adquirirla con mayor extension que el uso de los medallas, el estudio para su perfecto conocimiento, y el manejo de los libros que tratan de ellas. Quien las cultiva va adquiriendo de grado en grado los mas utiles conocimientos, y una vasta extension en el campo de las bellas lettras.*

"*Cada medalla es un diploma o instrumento autentico; que comprueba la verdad de la Historia; y no habrá en el mundo archivo de mas seguros y antiguos documentos.* * * * *El estudio de la antigüedad es cosa que no debemos jamas olvidar y abandonar segun Claudiano;*

Nec desinat unquam
Tecum Graia loqui, tecum Romana vetustas."

On the Formation of Dibenzyl by the Action of Ethylene Chloride on Benzol in the Presence of Aluminium Chloride. By William H. Greene.

(*Read at the Meeting of the American Philosophical Society, October* 17, 1879.)

By a series of the most remarkable chemical investigations of late years, MM. Friedel and Crafts have shown that the radicles of the saturated hydrocarbons can be grafted upon the benzol nucleus by the action of aluminium chloride upon a mixture of benzol and the monatomic chlorides, bromides, etc. Thus, on passing methyl chloride into benzol in which aluminium chloride is suspended, all of the methyl derivatives of benzol, from toluol to hexamethyl benzol, may be formed, according to the proportions of benzol and methyl chloride which are brought into contact. In the same manner, the ethyl, propyl, and other derivatives of benzol may be obtained abundantly.

In these reactions, hydrochloric acid is disengaged, and the explanation proposed by Friedel and Crafts supposes the reaction to take place in two phases: In the first, a compound of benzol and aluminium chloride is formed, with elimination of hydrochloric acid.

$$C^6H^6 + Al^2Cl^6 = C^6H^5.\ Al^2Cl^5 + HCl$$

In the second, the aluminium-benzol compound reacts upon the mona-

tomic chloride present, the organic radicle entering the benzol nucleus, and aluminium chloride being reformed.

$$C^6H^5.\ Al^2Cl^5 + CH^3Cl = C^6H^5.\ CH^3 + Al^2Cl^6$$

A small quantity of aluminium chloride serves for the preparation of an indefinite quantity of the new hydrocarbon.

By the action of aluminium chloride on the monatomic chlorides alone, hydrochloric acid is also eliminated, and the radicle is condensed. Hence, the reaction which would take place between benzol and a polyatomic chloride under the same circumstances cannot be entirely foreseen. It seems possible that in the case of ethylene chloride, for example, both atoms of chlorine might be replaced by phenyl groups, but it would seem more probable that, after the first substitution, one molecule of hydrochloric acid would be removed from the ethylene chloride, and that a more condensed hydrocarbon, styrol, would be formed. However, the first reaction is that which actually occurs.

When aluminium chloride is introduced into a mixture of benzol and ethylene chloride, the reaction begins in the cold, and becomes energetic on the application of heat. Hydrochloric acid is disengaged abundantly; when the reaction has ceased, the mixture is thrown into water to separate the aluminium chloride, and the oily liquor which separates is heated with alcoholic potassium hydrate, in order to decompose any remaining ethylene chloride.

After washing and drying the product, it yields, on fractional distillation, very nearly the theoretical quantity of dibenzyl, after which a thick oily mixture remains, which does not completely distill at 200° in a vacuum. This mixture consists of condensation products, and yields no satisfactory results, as it cannot well be fractionated, and does not solidify in a freezing mixture.

Pure dibenzyl melts at 52.5–53°, and boils at 279°, under a pressure of 767 millimetres, the thermometer being entirely immersed in the vapor. This boiling point is lower than that given by Cannizarro and Rossi (284°), and higher than that indicated by Fittig (272°).

On Dioxyethyl-methylene, and the Preparation of Methylene chloride. By Wm. H. Greene, M.D.

(*Read before the American Philosophical Society, November* 21, 1879.)

With the exception of the diethyl ether of methylene glycol, all of the oxyethyl substitution compounds of methane have already been described. Orthoformic ether, $CH(OC^2H^5)^3$, was studied by Kay and Williamson, and is generally known as Kay's ether: orthocarbonic ether, $C(OC^2H^5)^4$, was discovered and described by H. Bassett: methyl-ethyl oxide has long been known.

By a reaction similar to that by which these ethers are formed, I have

isolated dioxyethyl-methylene, the reaction between sodium ethylate and methylene chloride taking place as indicated by theory.

The chief difficulty lies in the preparation of pure methylene chloride; the process described by Perkin, and depending upon the reduction of chloroform by zinc and ammonia, yields only small quantities of methylene chloride, and the direct chlorination of methylchloride yields equally unsatisfactory results. The method which, after numerous experiments, I have found to answer best, consists in the reduction of an alcoholic solution of chloroform by zinc and hydrochloric acid.

The zinc and chloroform mixed with several times its volume of alcohol are placed in a flask connected with a suitable condensing apparatus, and hydrochloric acid is added in small portions. The reaction develops considerable heat, and methylene chloride and chloroform distill over; when the reaction has somewhat subsided, and no more liquid distills, more hydrochloric acid is added, and a moderate heat is applied, if necessary. In any case, the mixture is heated towards the close of the operation, until alcohol begins to distill in quantity. The operation is then arrested, and the product in the receiver is washed, dried and rectified, that portion which passes below about 53° being retained. The residue is returned to the flask and again submitted to the action of the zinc and hydrochloric acid. By several careful rectifications of the product passing below 53°, pure methylene chloride, boiling at 40–41°, is obtained.

By several operations in this manner the yield of methylene chloride may be brought up to about twenty per cent. of the chloroform employed.

Little or no advantage is gained by attempting to fractionate the product as it distills from the flask, so that the chloroform may flow back into the reducing mixture, for such distillation necessarily takes place in a stream of hydrogen which carries with it about as much chloroform as methylene chloride.

Dioxyethyl-methylene.—This compound was prepared by gradually introducing one molecule of sodium into a mixture of one molecule of methylene chloride and about four times the theoretical quantity of absolute alcohol, contained in a flask connected with a reflux condenser. After all of the sodium has been introduced, the mixture is heated on a water-bath for about an hour, and is then distilled. The distillate is fractionated, and the portion which passes below 78° contains all of the diethyl ether. It is agitated with a tolerably concentrated solution of calcium chloride, and the light ethereal layer is separated, dried over calcium chloride and carefully rectified, until a liquid is obtained which boils at 86–89°.

Dioxyethyl-methylene so obtained is an ethereal liquid, having a penetrating, pleasant odor, somewhat recalling that of mint. Its specific gravity at 0° is 0.851, and it boils at 89°, under a pressure of 769 millimetres. It is slightly soluble in water, from which it may be separated by the addition of calcium chloride; it mixes in all proportions with ether and alcohol, and it cannot readily be separated from its alcoholic solution if much alcohol be present; in such a case, fractional distillation and treatment of the portion which passes below 78° with solution of calcium chloride, effect the separation.

On the Coördination of the Various Methods of Expressing Thought as Applied to the System of Public School Instruction. By Lewis M. Haupt, C. E., Prof. of Civil Engineering, University of Pennsylvania.

(*Read before the American Philosophical Society, November* 21, 1879.)

Language, in its most general signification, is any medium by which thoughts or ideas may be conveyed from one person to another, and the avenues through which it affects the human intelligence are the senses.

In transmitting an idea, the senses may be called into action either singly or in combination. Thus speaking involves the sense of hearing, for a person born deaf must of necessity be dumb also. We may therefore regard the vocal organs and the ear as complementary functions for the transmission and reception of audible intelligence. These may be supplemented or entirely supplanted in their absence by the hand and eye, also complementary. In both of these cases the vocal organs and hand are the media of, while the ear and eye are the guides to, the proper form of expression.

From this it follows that there may be two distinct forms of language, namely, *Oral*, or that proceeding from the mouth, as in speaking, and *Graphical*, or that produced by the hand, as in writing, drawing, and printing. *Oral* language appeals to the ear of the recipient, *Graphical*, to the eye, for the correct interpretation of the idea intended to be expressed. If the same meaning be given to a combination of words, by the recipient, as was intended by the originator of an idea, then the result will be an identity of thought and a mutual understanding resulting in harmony. But as words have many meanings, the same words may produce very different impressions upon different minds even under similar circumstances, hence, to avoid misunderstanding, with its attendant confusion or discord, it is desirable to employ, if possible, a less ambiguous form of language.

A single instance will serve to illustrate this proposition.

Let the name of a substance, as *iron*, be mentioned. An audience composed of physicists, chemists, engineers, artisans, artists and literati immediately begin to think of some of its characteristic properties.

While the man of letters may regard it as a rigid, incombustible substance, the chemist considers it flexible and burns it with great brilliancy; while the prisoner may look upon it as an obstruction, the electrician makes it a channel of communication. The agriculturalist may use it as an implement of peace, whilst the soldier will make it an instrument of war. With the civil or mechanical engineer it is an important material of *con*struction, whilst with the military engineer it is an engine of destruction.

"The meaning of such a word is like the rainbow: everybody sees a different one, yet all maintain it to be the same."

It is thus with many words in our vocabulary, and hence arise sectarianisms, difficulties, violations of contracts and tedious litigation to determine the sense of some particular form of expression.

It is not necessary to dilate further upon the ambiguities of language, nor of the many serious and sometimes comical mistakes resulting from

them, but a few suggestions may not be out of place as to the necessity for more extended instruction in that branch of it which relates to the expression of ideas by graphical representations and especially by drawings.

It is a matter of primary importance to the progress of civilization that every avenue for the interchange of thought should be unobstructed, that there may be an unification of purpose and action; and secondarily, that the media used to convey such thought should be unambiguous and of general application. Now, since all ideas must have for their subject matter things physical or metaphysical, it follows that there may be a different form of language used in giving expression to each. As most physical conceptions treat of tangible objects, having form, and as such form or line of apparent contour is the first characteristic observed by the eye, and is more or less familiar to all persons living within the habitat or range of the object, it is natural that this form, more or less conventionalized or symbolized, should have been used to represent the object in an unmistakable language.

In developing the intellectual faculties of mankind, beginning with the child, there is first the inception of an idea, derived from some form and an associated sound, expressing its name; this is followed by the repetition of the sound by the child, giving rise to vocal language which is developed in later years in the public school system of instruction by spelling and reading. Thus the first, or oral, division of language is cultivated, while the second, and more extensive in its range and application, the graphical, does not receive the attention which its importance deserves.

It is true that writing has long held an important place in our popular educational systems, and of late years drawing has also been introduced systematically, but as yet only so far as to cultivate the eye and hand in sketching outlines and shading, that is, in making pictures and elementary designs either for decorations or for the practice which such operations afford in estimating magnitude, distance and direction.

That important division of drawing which is the basis of the correct interpretation of all forms and magnitudes and is of the greatest practical importance to all artisans and many artists and professional men, is as yet entirely ignored.

I refer to a knowledge of elementary projections, without which a working drawing can neither be made nor understood, and the artisan destitute of it is obliged to acquire the practical knowledge for the successful application of his handicraft by long years of apprenticeship while he learns the uses of the various templates that may be placed in his hands by a master.

A moment's consideration will convince an observer that there are two methods of representing objects, viz.: 1st, as they *appear* to exist, constituting *perspective;* and 2d, as they *do* actually exist, as in *projections*, in which, relative position, form and magnitude are given. The perspective view is of little practical importance to the workman, as he is unable to obtain from it the data necessary to reproduce the object.

No two persons in an audience can see the same object from the same

point of view, and hence unless it be symmetrical with reference to a point in space, as a sphere, the line of apparent contour will be different to each. The magnitude will also appear larger or smaller according to the distance of the observer from the object. Thus, if a circular disk be held up before an assembly it will appear circular only to that person at the end of its axis, while to those in the plane of the disk it will appear to be a straight line, and to all others the ellipses of which the line and circle are the limits, thus verifying the aphorism of the poet Longfellow, when he says,

"And things are not what they seem."

With projections, however, the case is different, as, if understood at all, they can only convey one impression to the reader. But it must be confessed that they are no more intelligible without a knowledge of the principles upon which they were constructed than is a printed work to one ignorant of letters.

The principles of projections are, however, as simple as those of elementary geometry, upon which they are based, and can be readily comprehended by the pupils in our public schools. And a knowledge of these principles would enable many of them to work much more intelligently in the various trades in which they may thereafter become apprentices.

The application which may be made of such information is very extended. As a disciplinary study it is one of the first order, developing the conceptive faculties and enabling one to grasp an idea readily. It has its application in nearly all manufactured articles and in all constructions and designs, in wood, iron, stone, clay, or other materials. It is used constantly by the engineer, architect, builder, pattern-maker, iron or sheet metal-worker, stair-builder, stone-cutter, designer, and a host of others. It is the basis of all perspective drawings which are generally made by rule and without reason, and is essential to a correct interpretation of all suggestions relating to constructions of any kind. It is used to explain and reinforce verbal language, and should be so used whenever possible.

One of the most important applications of graphical language must not be overlooked. To the statistician as well as merchant it is valuable as furnishing at a glance information which if expressed in a mass of figures would be unintelligible. It cannot be surpassed as a method of exhibiting rapidly the distribution of population, of products, of poverty or wealth, of crime or morality, of vital, or in fact any statistics which may be expressed numerically. To the physicist it is also particularly useful in investigations into the properties of molecular or mass physics, and enables him to discover almost immediately the laws governing the motions of matter.

Fluctuations of prices, in the market values of daily commodities, may be more intelligently expressed by this means than any other and can be compared at a glance. In short, the number of intelligent and eminently practical applications that may be made of projections is almost limitless.

Its introduction would supplant a certain amount of mnemonical by rational and manual development, and would thus be a relief to a system already overtaxed with memorizing.

Another means of disseminating thought, as well as of developing the mental and manual faculties simultaneously, would be the introduction of type-setting in the public school as a weekly exercise, but as it is not the purpose of this article to discuss here the means and methods of industrial education, any further remarks on this head will be out of order.

It is merely intended to call attention to the fact that there is need of a more complete development of all the faculties used to convey or receive impressions and to coördinate them into a closer and more efficient system of instruction as a basis for the more intelligent expression of thought.

Stated Meeting, June 20, 1879.

Present, 5 members.

Vice-President, Mr. FRALEY, in the Chair.

A photograph of Mr. J. F. Mansfield, was received for insertion in the album.

Letters of acknowledgment were received from the Natural History Societies at Württemberg, April 1 (101, 102); Freiburg, Feb. 2 (101); the Societies at Harlem, Aug., 1877 (97, 98, 99); Lyons, Aug. 1, 1878 (I to XV); Edinburgh, Oct. 31, 1878 (100, Cat. III); the Royal Academy, at Amsterdam, Oct. 22, 1877 (100, Cat. III); New Hampshire Historical Society, June 16 (103); the Essex Institute (103); the U. S. Military Academy, at West Point (103); the New York Historical Society (103); the American Ethnological Society (103), and Astor Library (103); the Numismatic and Antiquarian Society (103), and Historical Society at Philadelphia (103); the Wisconsin Historical Society (103); and various members (103).

Letters of envoy were received from the Royal Academy, at Amsterdam, Feb. 7, 1879; Imperial Academy, at Vienna; Royal Academy, at Munich, April 10, 1879; Holland Society, Harlem, Dec., 1877; Government Surveyors, Victoria, Feb. 12; Greenwich Observatory, June 20; Meteorological Office; and Mrs. Sarah S. Pickering, May 19, 1879.

Donations for the Library were received from the Academies at Amsterdam, Bruxelles, Berlin, Vienna, Rome, and

Philadelphia; the Societies at Copenhagen, Harlem, Göttingen, Görlitz, Freiburg, Stuttgard, Liège, Lyons, Bordeaux and Salem; the Observatories at St. Petersburg, Munich, Paris, Greenwich and Cape Town; the University at Christiania; the Statistical Commission of Belgium; the Anthropological Society and Geological Institute at Vienna; the German Geological Society and Botanical Association, at Berlin; the Zoological Garden, at Frankfurt; the Geographical, Anthropological and Antiquarian Societies, Ethnographical Institution and Museum of Natural History, at Paris; the Physical, Linnæan and Geographical Societies, at Bordeaux; the British Association; the Astronomical, Meteorological, Geographical, Geological and Zoological Societies, Victoria Institute and London Nature; Mr. L. C. Miall, of Leeds; T. P. James, of Cambridge, Massachusetts; Mrs. Pickering, of Boston; the Cambridge Library and Museum of Comparative Zoology; Prof. J. D. Whitney, Prof. W. A. Norton and Silliman's Journal, of New Haven; the Brooklyn Entomological Society; the American Chemical Society and Mr. F. R. Rathbun, of New York; the Franklin Institute, Zoological Society, Medical News, American Journal of Pharmacy and International Committee of Philadelphia; the American Journal of Mathematics, at Baltimore; U. S. Smithsonian Institution and Wm. B. Taylor, of Washington; the Wisconsin Natural History Society; the Geographical Society and National Museum in Mexico.

A medal of Joseph Henry, was received from the engravers of the Mint, Messrs. Wm. and Chas. E. Barber, for which, on motion, the thanks of the Society were presented to the donors.

Mr. Henry Phillips, Jr., offered for the acceptance of the Society, under certain conditions, a copy of Sabin's Bibliotheca Americana, as far as published, which, on motion, was accepted for the Library.

No. 103 of the Proceedings, just issued, was laid upon the table for examination.

A simple and closely approximate diagrammatic solution

of the problem of squaring the circle was communicated by Prof. P. E. Chase. (See page 281.)

A communication entitled, "Eleventh Contribution to the Herpetology of South America," was received from Prof. E. D. Cope. (See page 261.)

The Committee on a Eulogy on Dr. G. B. Wood reported a recommendation that Dr. Henry Hartshorne be appointed in the place of Dr. Alfred Stillé, to prepare an obituary notice of the deceased, which was adopted.

Pending nominations 878 to 884 were read, and the meeting was adjourned.

Stated Meeting, July 18, 1879.

Present, 5 members.

Vice-President, Mr. FRALEY, in the Chair.

A photograph of Prof. John LeConte, and a vignette of Gen. F. E. Spinner, were received for insertion in the album.

Letters acknowledging the receipt of Proc. No. 102, were received from the Royal Danish Society, June 17; and of Proc. No. 103 from Prof. Steenstrup; Mr. A. Agassiz; the New Jersey Historical Society; Prof. Fred. Prime; the Maryland Historical Society; the Engineers' Club; the U. S. Naval Observatory; Mr. Asaph Hall; Prof. Kirkwood; the Davenport Academy; the Georgia Historical Society and Prof. John LeConte.

Letters of envoy were received from the Batavian Observatory, May 7; Dr. H. Scheffler, of Braunschweig, April 20; the Bureau des Longitudes per U. S. State Department; and the Engineers' Club of Philadelphia.

On motion, the Librarian was authorized to supply a copy of Proceedings No. 97 to the Cherbourg Natural History Society.

On motion, the Journal of Medical Sciences was ordered to be placed upon the list of correspondents to receive the Proceedings.

An offer from the State Librarian of Michigan to exchange was accepted.

Donations for the Library were received from the Academies at St. Petersburg, Berlin, Brussels, Rome and Minneapolis; from the Geographical Societies of Russia, Paris and Bordeaux; the Observatories at Prag and Adelaide; from the Bureau des Longitudes; London Astronomical Society; and the Corporation of the City of London; Essex Institute; Boston Society of Natural History; Brooklyn Entomological Society; American Chemical Society and the New York Mercantile Library Association; Franklin Institute, American Pharmaceutical Association, Union League and Engineers' Club of Philadelphia; Smithsonian Institution; and Argentine Scientific Society; Yale College; Wabash College; U. S. Engineers' Department; Mexican Agricultural Bureau; Melbourne Mining Bureau; Young Men's Association at Buffalo; Dr. Scheffler, of Braunschweig; Canadian Naturalist; Silliman's Journal; New York Entomological Society, and Mercantile Library; Journal of Pharmacy, Journal of the Medical Sciences, Pennsylvania Magazine of History, &c., Prof. Frazer, Dr. Genth, Mr. Benson, Prof. Jacques, and Dr. Gross.

A communication was received, entitled, "On Pyrophyllite" from Schuylkill Co., Pa., by Dr. F. A. Genth (p. 279).

Mr. Lesley described a recently discovered ancient buried river channel crossing the Allegheny river twice, from the mouth of the Clarion, above and below Parker, at the northern limit of Armstrong County.

As Mr. Carll has shown that the preglacial Allegheny river had its heads in the high ridge south of Tidioute, in Venango County, it is evident that the Clarion river was then the main Allegheny river; which explains the ancient double curve at Parker. After the ice had retreated from the northern country, leaving all the valleys choked with drift, the combined waters which until then had entered the basin of Lake Erie, at Dunkirk, in New York State, broke away through the ridge below Tidioute, and cut the present straight channel at Parker, across and 100 feet lower than the ancient channel.

Pending nominations No. 878 to 884, and new nomination 885, were read.

Pending nominations 878 to 884 were balloted for, and after scrutiny of the ballot boxes by the presiding officer, the following persons were declared duly elected members of the Society:

Prof. Charles Martins, of Montpellier, France.

Sir George Biddle Airy, Astronomer Royal of Great Britain.

Mr. Charles M. Wheatley, of Phœnixville, Pa.

Mr Andrew S. McCreath, of Harrisburg, Pa.

Prof. Ira Remsen, of Baltimore, Md.

Prof. E. Reneviers, of Lausanne, Switzerland.

Mr. Benjamin B. Comegys, of Philadelphia.

And the meeting was adjourned.

Stated Meeting, August 15, 1879.

Present, 2 members.

Secretary, Dr. J. L. LeConte, in the Chair.

A portrait of George Ord was presented by Dr. M. Hay, for insertion in the album.

Letters accepting membership were received from Mr. Charles M. Wheatley, dated Phœnixville, July 24, and Mr. Andrew S. McCreath, dated Harrisburg, Pa., July 24.

Letters of acknowledgment were received from the Reale Academia dei Lincei in Rome (101, List. Cat. III); and the Boston Society of Natural History, July 21 (103, List. Cat. III).

Letters of envoy were received from the Zoologico-Botanical Society of Vienna, May 20; and the Natural History Society of Görlitz, March 2, 1879.

Donations for the Library were received from the Institute of France; the Geological Institute, Zoologico-Botanical Society, and Anthropological Society at Vienna; M. Joseph de Lenhosáck, of Buda-Pest; the Societies at Gör-

litz and Bremen; Prof. F. Sandberger; the Royal Danish Academy; the Geographical and Anthropological Societies, School of Mines, Polytechnic School, and Revue Politique, of Paris; the Linnæan and Geographical Societies at Bordeaux; the Royal Institution, Astronomical, Meteorological, Geographical, Geological, Zoological, Asiatic Societies, and Prof. Bickerton, of London; the Royal Geological Society of Ireland; the Canadian Naturalist and Survey of Canada; Essex Institute; Boston Natural History Society; Museum of Comparative Zoology; Old Colony Historical Society, at Taunton; North American Entomologist; American Journal of Otology; American Chemical Society of New York; Franklin Institute, American Journal of Pharmacy and Medical News and Library, in Philadelphia; the U. S. Naval Observatory, Engineer Department, Department of the Interior, and the Department of the U. S. A.; the Cincinnati Society of Natural History; Indiana State Geological Survey; American Antiquarian; Botanical Gazette; and M. Barcena, of Mexico.

A donation for the Cabinet was received from M. Joseph Von Lenhossák, of Buda-Pest, per M. Eugene Turnoosky, M. D., 73 West Forty-fifth street, New York, March 30, 1879, viz., a cast of the skull figured and described in his work, entitled, "Deformations, &c.," received of same date for the Library.

A communication entitled, "Surface Geology of Southwest Pennsylvania and adjacent portions of West Virginia and Maryland, by John J. Stevenson, Professor of Geology in the University of the city of New York," was read. (See page 289.)

And the meeting was adjourned.

Stated Meeting, September 19, 1879.

Present, 10 members.

Vice-President, Prof. KENDALL, in the Chair.

Letters accepting membership were received from Prof. J. Reneviers, dated Lausanne, Aug. 5, 1879; from Prof.

Ch. Martins, dated Montpellier, Aug., 1879; and from Sir Geo. B. Airy, dated Royal Observatory, Greenwich, London, S. E., Aug 12, 1879.

A photograph of Charles Martins was received for insertion in the album.

Letters of acknowledgment, were received from the Astronomical Society at Leipsig, dated Aug., 1879 (101); the Natural History Society at Newcastle-upon-Tyne, dated Aug. 13, 1879 (102); the Philosophical Society at Glasgow, dated Sept. 5, 1879 (102); the Society of Antiquaries at London, dated Aug. 5, 1879 (102); and the Free Public Library at New Bedford, dated Sept. 11, 1879 (103?).

Letters of envoy were received from the Royal Irish Academy, dated Aug., 1879; and the U. S. Naval Observatory, dated 1879.

Letters asking for back numbers of the Proceedings were received from Trübner & Co., in behalf of the Geological Survey of India (II 15, 17, 19; IV 28, VII 62, 63, 64, X 73, XIV 92), and in behalf of two public libraries in London (XV Trans. 2, 3; Proc. 101, 102).

A letter from the Society "Amigos del Pais" of Santo Domingo, July 21, forwarded by H. Bellini, Dominican Consul, Aug. 13, requesting Trans. XVI was read.

Donations for the Library were received from the Department of Mines, Melbourne; the Observatory at Adelaide; the New Zealand Institute; the Asiatic Society of Japan; the Academies at Berlin, Rome, Bruxelles, and Boston; Prof. C. A. Dohrn of Stettin; the Geographical Societies at Paris and Bordeaux; the Museum of Natural History and Revue Politique, Paris; the Geological and Antiquarian Societies at London; Profs. G. J. Brush and E. S. Dana, of New Haven; Mr. H. C. Bolton of Hartford; the American Chemical Society; the North American Entomologist; the Franklin Institute, Journal of Pharmacy, College of Physicians, and Medical News; the Departments of War, Engineers, and Agriculture, at Washington; the Observatory at Mexico; and Dr. Hugo von Meltzel, Koloszvar, Hungary.

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A communication was read entitled, "The Cosmogony of Laplace. By Daniel Kirkwood." (See page 324.)

A communication was read entitled, "The Philosophy of the Biblical Account of the Creation. By Aug. R. Grote, A. M." (See page 316.)

On motion it was resolved that the Hall Committee be authorized to provide additional shelving for the Library.

And the meeting was adjourned.

Stated Meeting, October 3, 1879.

Present, 9 members.

Vice-President, Mr. ELI K. PRICE, in the Chair.

A letter accepting membership was received from Mr. B. B. Comegys, dated Philadelphia, Sept. 27, 1879.

A letter of acknowledgment was received from the Royal Geological Society of Ireland (101 ; Cat. III).

Letters of envoy were received from the Botanical Garden at St. Petersburg, Sept. 1 ; the Harvard College Observatory, Sept. 15 ; the Flora Batava, per the Consul-General of the Netherlands, New York, Sept. 25 ; and the New York State Library, Sept. 19, 1879.

Donations for the Library were received from the Botanical Garden at St. Petersburg ; the Flora Batava ; the Annales des Mines, and Revue Politique ; the Commercial Geographical Society at Bordeaux ; Harvard College Observatory ; Prof. O. C. Marsh ; the American Chemical Society ; the New York University ; the Engineering and Mining Journal ; the Brooklyn Entomological Society ; Botanical Gazette ; and the American Journal of Pharmacy,

A communication was received, entitled, "Additional Notes upon the Collection of Coins now on exhibition in the Pennsylvania Museum and School of Industrial Art, Memorial Hall, Fairmount Park, Philadelphia. By Henry Phillips, Jr." (See page 327.)

Mr. Lesley exhibited a mounted set of uncolored proof sheets of the contour curve map of Morrison's Cove, Canoe Valley and contiguous region to the west, extending to the crest of the Alleghany Mountain, in Blair County, surveyed and drawn by Mr. H. N. Sanders, Assistant Geologist on the Second Geological Survey of Pennsylvania, and executed on stone by Mr. Julius Bien, of New York, for publication in Report of Progress T, by Mr. Franklin Platt, Assistant Geologist. He pointed out its most striking topographical and geological features.

Pending nomination No. 885 was read.

On motion, the Librarian was authorized to complete the printing of the Catalogue.

And the meeting was adjourned.

Stated Meeting, October 17, 1879.

Present, 18 members.

Vice-President, Mr. FRALEY, in the Chair.

Letters of acknowledgment were received from the Belgian Academy (102, 103) and the Royal Zoological Society in Amsterdam (102, 103).

Donations for the Library were received from the Victoria Mining Bureau; Russian Academy; Revue Politique; Victoria Institute; Royal Asiatic Society; Cobden Club; Harvard College; Silliman's Journal; Prof. Newberry; Engineering and Mining Journal; North American Entomologist; Franklin Institute; Journal of the Medical Sciences; Medical News; U. S. Departments of the Navy and Education; Mr. A. R. Grote; Mr. Philip H. Law, and the Ministerio de Fomento.

The death of Henry C. Carey, at Philadelphia, on the 13th inst., in the 86th year of his age, was announced by Mr. Fraley; and, on motion, Prof. Robert Ellis Thompson,

Professor of Political Economy in the University of Pennsylvania, was appointed to prepare an obituary notice of the deceased.

Dr. Le Conte, on behalf of himself and others, presented to the Society a portrait in oils of the late Joseph Henry, copied by Mr. Ulke, of Washington, from Mr. Ulke's original portrait from life, painted in 1876.

A communication was read, entitled, "On the formation of dibenzyl, by the action of ethylene chloride on benzol in the presence of aluminium chloride. By Wm. H. Greene." (See page 345.)

Mr. Lesley exhibited a photograph fac-simile of a contour map of a region of Western Pennsylvania, extending from Johnstown in Cambria County on the east and Indiana on the north, to Latrobe on the south and Greensburg and Saltsburg on the west. He described its eventful history: how it had been surveyed and drawn by himself, under orders from the President of the Pennsylvania Railway Company, for geological purposes, in 1852–3–4; lost for twenty-five years; recovered without explanation in the spring of 1879; and recently photographed in duplicate by Mr. Julius Bien, of New York, for future completion and publication in the Reports of the Geological Survey.

Pending nomination No. 885 was read and postponed, on account of the absence of its nominators.

The resolutions of Dr. Le Conte, offered May 2, and postponed from May 16, were called up for consideration and, after debate, passed (with an amendment of the third resolution), as follows:

Resolved, That the further consideration of processes for economically utilizing anthracite coal-dust be indefinitely postponed.

Resolved, That the Committee appointed to investigate the subject be discharged, and the thanks of the Society be tendered to the Committee, for the industry and patience with which they have endeavored to come to a decision on the subject.

Resolved, That the prize heretofore offered by the Society for a process for the economical use of anthracite coal-dust, be withdrawn.

And the meeting was adjourned.

Stated Meeting, November 7, 1879.

Present, 9 members.

Vice-President, Mr. E. K. PRICE, in the Chair.

A photograph of Mr. Juhlin Dannfelt was received for insertion in the album.

A letter accepting his appointment to prepare an obituary notice of the late Henry C. Carey was received from Prof. R. E. Thompson, dated October 22.

Letters of envoy were received from the U. S. War Department Nov. 6, and Smithsonian Institution, Nov. 4.

Donations for the Library were received from M. Dannfelt, of Stockholm; the Academies at Copenhagen, Berlin and Brussels; the Vaudois Society; the Geographical Society and Political Review of Paris; Annales des Mines, and Museum of Natural History; Commercial Geographical Society at Bordeaux; Nova Scotia Institute; Essex Institute; Boston Natural History Society; Cambridge Museum; American Antiquarian Society; American Journal of Sciences; American Chemical Society, and Journal of Otology, N. Y.; Brooklyn Entomological Society; North American Entomologist; Pennsylvania Historical Society, Medical News, American Journal of Pharmacy, and Mr. H. Haupt, Jr., of Philadelphia; Second Geological Survey of Pennsylvania; Prof. Himes, of Carlisle, Pa.; the Cincinnati Society of Natural History; Dr. Saml. D. Gross; Mr. Geo. W. Ranck; the American Antiquarian, of Chicago; the Ministerio de Fomento; and the U. S. War Department.

The death of Prof. James Clerk Maxwell, of England, Nov. 5, 1879, in the 48th year of his age, was announced by the Secretary.

Dr. LeConte exhibited a piece of iron pipe much corroded and obstructed by deposit from city water during the last thirty years, as illustrating the formation of brown hematite ore beds. The pipe connected the Juniper street main with the laboratory of the U. S. Mint, and leaked from having spontaneously parted.

Pending nomination 885, and new nominations 886, 887 and 888 were read.

And the meeting was adjourned.

Stated Meeting, November 21, 1879.

Present, 12 members.

Vice-President, Mr. FRALEY, in the Chair.

A photograph of Mr. H. Phillips, Jr., was received for insertion in the album.

Letters of acknowledgment were received from the R. Society, Tasmania, Hobartstown, July 17, 1878 (99); from the R. Academy, Lisbon, July 28, 1879 (101); from the R. Observatory, Brussels, Nov. 3 (102, 103); and from the Victoria Institute, London, July 2 (102).

Letters of envoy were received from the Car. University, Lund, Aug. 15; R. Saxon Society, Leipsig, May 29; Holland Society, Harlem, June 10; and the Second Geological Survey of Pennsylvania, Nov. 17, 1879.

A letter, offering on the part of the family of the late Joseph Henry to restore for use to the Society back numbers of the Proceedings, was received from Prof. Baird, dated Smithsonian Institution, Washington, Nov. 15.

Donations for the Library were received from the Academies at St. Petersburg, Berlin, Bordeaux, Madrid, Lisbon and Dublin; the Observatory at Adelaide; the University at Lund; the R. Societies at Hobartstown, Leipsig, Göttingen and London; the Anthropological and Geographical Societies, Geological and Meteorological Institutes at Vienna; the German Geological Society; Jablownowski Society and Natural History Society at Leipsig; the Natural History Society at Bonn; Zoological Garden at Frankfurt; Holland Society at Harlem; Geographical and Anthropological Societies, and Revue Politique, Paris; Physical, Geographical and Linnæan Societies at Bordeaux; Zoological, Geographical, Meteorological and Astronomical Societies,

and Victoria Institute at London; Philosophical and Literary Society at Leeds; R. Cornwall Polytechnic Society; Mr. James Henry, of Dublin; the Mining Bureau at Melbourne; the Wesleyan University, Connecticut; American Chemical Society, N. Y.; Princeton Museum of Geology and Archæology; Franklin Institute; and Pennsylvania Geological Survey.

The death of Mr. John Walter Harden, in West Philadelphia, Nov. 8, aged 63 years, was announced by Mr. Lesley, who was appointed to prepare an obituary notice of the deceased.

A communication, entitled "On Dioxyethyl-methylene, and the preparation of Methylene-chloride, by William H. Greene, M.D.," was read. (See page 346.)

Dr. Greene stated that a paper on the formation of *dibenzyl* by the reaction described by him at the meeting of Oct. 17, had been published by M. Silva in the Comptes Rendus of Oct. 6. Priority must therefore be granted to M. Silva, although the journal containing the results of his investigations did not arrive here until after the presentation of Dr. Greene's paper.

Mr. Haupt made a short verbal report of the progress of the extension of the U. S. Trigonometrical (Coast) Survey in Berks, Chester and Lancaster counties, Pennsylvania.

A communication, entitled "On the Coördination of the various methods of expressing thought as applied to the system of public school instruction, by Lewis M. Haupt, C. E., Prof. Civ. Eng., Univ. Pa.," was read. (See page 348.)

Mr. Eli K. Price referred to the growing use of graphical testimony in the law practice of the courts.

Mr. Briggs described the recent invention of a perpetual battery by Profs. Houston and Thompson, exhibited at a meeting of the Franklin Institute.

Notes on the etymology of ἡράκλης were read by Mr. Lesley.

The minutes of the last meeting of the Board of Officers and members in Council were read.

Pending nominations 885 to 888, and new nomination 889 were read.

Mr. Fraley reported the receipt of $131.81, being the last quarterly interest on the Michaux Legacy fund, due Oct. 1.

And the meeting was adjourned.

Stated Meeting, December 5, 1879.

Present, 13 members.

Vice-President, Mr. FRALEY, in the Chair.

A letter enclosing a photograph for insertion in the album was received from Prof. Richard Akerman, dated Stockholm, Nov. 13, 1879.

An acknowledgment of the receipt of Proc. No. 103, was received from Professor J. J. Stevenson, dated New York, Nov. 28.

A letter of envoy was received from the Central Physical Observatory at St. Petersburg, dated Oct. 1879.

A letter was received from the Cleveland Library Association requesting exchanges.

Donations for the Library were received from the Senkenburg Society of Natural Sciences; Revue Politique; Commercial Geographical Society, Bordeaux; London Nature; Geological Survey of Canada; Boston Society of Natural History; Yale College; Mr. Redfield, of Philadelphia; the Botanical Gazette; North American Entomologist; and the Ministerio de Fomento, Mexico.

The death of M. Michel Chevalier, at Paris, Nov. 28, aged 73, was announced by the Secretary.

Mr. Moncure Robinson was appointed to prepare an obituary notice of the deceased.

Mr. Lesley exhibited a slab of roofing slate covered with casts of *Buthotrephis flexuosa*, obtained by Prof. Frazer for the Museum of the Second Geological Survey of Pennsylvania, from the Rev. Prof. Rendall, of Lincoln University,

who obtained it (with several others) from a miner in the Peach Bottom slate quarries on the Susquehanna river near the Maryland State Line. The other slabs are in the York Museum, in York County, Pennsylvania. The species of fucoid was determined by Prof. Lesquereux from a careful drawing, which he pronounced sufficiently characteristic.

The great importance of this discovery in confirming the long suggested possible existence of Hudson river slates (Lower Silurian, No. 111) so metamorphosed as to be almost totally destitute of organic remains, in the so-called subpalæozoic, hypozoic, hypazoic, azoic, or eozoic (Huronian, Cambrian, or Laurentian) belt of the Atlantic sea coast, was dilated upon and discussed by Prof. Lesley, Prof. Frazer, Prof. Cope, and Prof. Hayden. Mr. Lesley said:

Prof. Lesquereux has just determined *Buthotrephis flexuosa* on a slab of roofing slate from the quarries on the Susquehanna river near the Maryland line. This is a most important discovery. Prof. Frazer has been studying the roofing slate belt and adjoining chlorites for several years in connection with his York and Lancaster county work. He never found any traces of organic life, nor could hear of any. But he found several curious forms in the rocks across the State line in Maryland, one of which looked like a flattened *Orthoceras*. Prof. James Hall and Mr. Whitfield were disposed to consider them not organic. They have been figured for the American Philosophical Society's Proceedings and for the Reports of the Survey. These are the only fossils ever seen in that region to our knowledge. The slab of *B. flexuosa*, is in our Museum and will be figured. Prof. Frazer received it from a Presbyterian clergyman, President I. N. Rendall of Lincoln University, who got it from a miner, as part of a mass four or five times as large, the remainder of which he sent to the York Museum, York, Penna., in acknowledgment of aid from the citizens to the university. There seems to be no doubt that the slabs came from the Peach Bottom quarries as asserted.

There are two species of *Buthotrephis* known, one in the Trenton, three in the Hudson river slates, one in the Clinton. One is reported from the Devonian of Russia. Several from the Subcarboniferous remain unstudied. *B. flexuosa* is characteristic of the Hudson river. It is in the upper part of the Hudson river formation, along the foot of the Kittatiny or Blue or North Mountain, on the Lehigh river, in eastern Pennsylvania, that we have our Slatington and other roofing slate quarries; and no trap is known in the neighborhood, and no reason can be assigned for excessive metamorphosis of structure (not of lithology); but on the Maryland line, a trap dyke many miles long has been followed by Prof. Frazer, across Lancaster

county, from the Peach Bottom roofing slate belt *through the Gap Nickel mine*, north-eastward into the Welsh mountains. But, as the roofing slate belt is several miles long, I can see no important connection between the trap at one end of it and its metamorphism.

Prof. Frazer feels sure that the roofing slates are part and parcel of the chlorite slate formation which makes such a show along the river for miles north of the quarries. But the structure is very obscure. To the north of the (south dipping) chlorites, a bold, double-crested anticlinal (of Tocquan creek) crosses Lancaster and York county, and is finely exposed upon the two banks of the Susquehanna river, bringing up massive gneisses, &c., evidently referable to our Philadelphia gneisses, to those of the Welsh mountains west of the Schuylkill river, and to those of the Highlands of New Jersey and New York states. The chlorite slates are always seen in this region in juxtaposition with limestones which we feel confident are No. II ("Magnesian" "Calciferous"); but the structural connection is not yet quite satisfactory. Mr. C. E. Hall is disposed to look upon them all along the Chester county "south valley hill," and across the Schuylkill into Philadelphia, and towards Trenton, as No. III (Hudson river) metamorphosed.

Everything points towards nonconformable basins or outlying patches of metamorphosed Silurians in the heart of our Azoic country of southern Pennsylvania and Maryland, and this discovery of *B. flexuosa* leaves very narrow room for further doubt on the subject.

Prof. Frazer gave a partly detailed description of the section along the Susquehanna,—an analysis of the difficulties he encountered in making out its true structure,—and the doubts which still hang over the relationship of the roofing slate belt to the chloritic, mica slate and gneissoid areas, on each side of the great Tocquan anticlinal.

Prof. Frazer said that in reference to the effect of the determination of the Peach Bottom slates as of Hudson river age, a word of explanation would make its extent clear.

The Susquehanna section was prepared carefully foot by foot with a perfectly accurate 200 ft. = 1 inch R. R. plotting in the hand. The exact position of every station (the stations were all 100 feet apart) and the outline of the shore and curves in the road were given on the plot, while the inner side of the outer rail was painted with the number corresponding to each station. Locations were therefore almost perfectly accurate. From Columbia to Turkey hill ($\pm$ 5 miles south) was filled with limestone. Chlorite slates come in abruptly at Turkey hill, and last along the shore (still going south) to within a mile or so of Safe Harbor, when

they gradually alter to mica schist, and beyond Safe Harbor to true gneiss. This lasts for about eleven miles, with its dips about evenly divided by the Tocquan creek, the northern portion dipping gently N. W. and the southern portion S. E. Whatever be the age of the chlorite series therefore, and whatever be the age of the Tocquan rocks, the latter interpose a limit to the extent to which a change of horizon of the former may affect the structure. The Tocquan anticlinal is too broad and flat and extensive, not to mention its strongly marked lithological characteristics, to be anything else than what it seems. Nobody can invert either of its limbs. It is a Safe Harbor to the bewildered stratigrapher; and a Mount Ararat to the ark of the propounder of theories. This welcome element of structure, however, fades out into inconclusive and rare exposures near Fishing creek, after which the chlorite series begins to appear, and continues, with numerous exposures, to a point a little less than half a mile north of Peters creek, quartz entering largely into the composition of the rocks which are otherwise highly convoluted, green and unctuous. Here come in the Peach Bottom slates with but little time for transition, and pass, after a breadth of a few hundred yards, equally abruptly, into chlorites again, and finally into a greenish chloritic quartzite, which is the northern boundary of Peters creek (when in flood). This greenish quartzite puzzled the speaker so much that in his report written two years ago, but not issued, he deemed the matter important enough to present two views of its age. He says, page 135, "The structure supposed in the section will not assign to this rock contemporaneity with the Chikis quartzite, nor form a continuity with the quartzites to be noted further down the river" (which are ascribed to Potsdam age). "But the interpretation of the stratigraphy here is of the greatest difficulty," &c., &c. Again, page 141, another structure than that adopted is given which makes "the hydromica schists in the basin of the first synclinal the lower limestone slates or hydro mica schists." Not because of any lithological considerations, however, but solely on the hypothesis that the column of formations appear in their normal order, which needs to be established.

In other words, if the Peach Bottom slates be established as of Hudson river age, the real difficulty would seem not be a stratigraphical one; for they might be supposed to be deposited unconformably on any of the older series, without the intervening members of the column. But the only difficulty—not an insurmountable one perhaps—will be to account for the alteration of the argillaceous strata characteristic of that horizon, to the highly crystalline magnesia hydromicas which remind one so much of what the speaker asks permission still to regard as the *true chlorites*—the chlorites of the South Mountain.

It is interesting in this connection, to call attention to the analysis of these Peach Bottom slates, made at my request by Mr. A. S. McCreath, at Harrisburg.

The specimen is from J. Humphrey & Co.'s Quarry, half a mile east of Delta, York county.

Silicic Oxide (SiO^2)	55.880
Titanic Oxide (TiO^2)	1.270
Sulphuric Oxide (SO^3)	0.022
Alumina (Al^2O^3)	21.849
Ferrous Oxide (FeO)	9.033
Manganous Oxide (MnO)	0.586
Cobaltous Oxide (CoO)	trace
Lime (CaO)	0.155
Magnesia (MgO)	1.495
Soda (Na^2O)	0.460
Potash (K^2O)	3.640
*Carbon (C)	1.794
Water (H^2O)	3.385
Iron Bisulphide (FeS^2)	0.651
Total	99.800

Mr. McCreath added a note which is not at hand, but to the effect that he believed this 1.794 p. c. of carbon (so common an ingredient in Hudson river rocks) was not in the form of graphite.

Carbon might be looked for lower as well as higher than the horizon assigned to the chlorite series, but, if the former, it would be more likely to appear as graphite.

The following extracts from a letter of President Rendall to Professor Frazer, in answer to further inquiries as to the genuineness of the fossil, are of importance in view of the length of time which may possibly elapse before another specimen is brought to light.

In 1875, I visited the quarries in company with Dr. S. B. Howell of Philadelphia. ..... I am not certain whether he obtained a specimen at that time. I think he did of the rock but not of the fossil. I went from quarry to quarry inquiring of the old workmen and of the owners, whether they had at any time seen any marks on the slate. The answer for the most part was no; but two of the more experienced workmen said they had noticed some marks, but they had a vague notion of them, and could not give an adequate description. They thought they had seen them recently, and searched some piles of slate without success.

I left an order with them to preserve for me any specimens which might turn up. They promised in a friendly way to keep whatever might be found. There was no promise of money. They did not expect reward, and had no reason to procure specimens to deceive, unless for the pleasure of deceiving. They were to notify the resident Pres. minister who promised to take possession for me. In a little while they sent word to him that they had found some marks on a slab. He omitted to go for it, or to notify me,

* Average of three determinations.

and after keeping it for some time, they threw it out among the rubbish. In 1876 (in the fall), I was on the ridge myself, and went to each of the quarries, and learned what I have just written; and at one of the quarries the superintendent said they had found a few days before a slab with some marks on it, and had thought of me, but not seeing that the marks were indicative of anything especially interesting, they had thrown it away over the edge of the rubbish pile. The superintendent called three or four workmen, and directed them to search for the block which he said could not be buried very deep.

We threw the top pieces over, rolling them further down, and in perhaps half an hour came upon the piece they were looking for, and with it the piece which is in your possession. All the indices are in favor of its origin in the quarry at Peach Bottom. There was the first report that certain marks had been seen, but that they were rare. The workmen were not in the habit of finding and holding for sale specimens of the rock. These specimens were not regarded as interesting or valuable, but were thrown away, and only recovered as I have said. The block I speak of must have weighed, as I saw it, not less than seventy-five pounds.

The State geologist has the opportunity of identifying the slate on which the stems of the fucoid are with the slate of Peach Bottom, or of some other locality. Until some evidence is obtained that ends all doubt, this would be a confirmatory mark. The slate at Peach Bottom is not identical with the Lehigh slate. But I have no doubt the evidence on the spot can be made sufficient. The fossil is rare. Any one might have to wait there a long time to see one. ..... I do not know the name of the men, who found the piece for me, but I can get them by correspondence. ....

Prof. Cope presented a communication entitled, "Second contribution to a knowledge of the Miocene Fauna of Oregon."

The paper for the Magellanic premium being called up, and no report from the Board of Officers presented, a special meeting of the Board was ordered; and on motion of Mr. Briggs, it was resolved that a Committee of five be appointed by the Chair for considering and reporting upon the value of the claim. The Chair appointed Mr. Briggs, Prof. Chase, Prof. Kendall, Prof. E. H. Houston, and Mr. Coleman Sellers.

The Treasurer's annual report was read and referred to the Finance Committee.

Pending nominations Nos. 885 to 889, and new nominations 890 to 892, were read.

And the meeting was adjourned.

Second Contribution to a Knowledge of the Miocene Fauna of Oregon.

By E. D. Cope.

(*Read before the American Philosophical Society, December* 5, 1879.)

Two contributions to the present subject have been heretofore made by the writer, viz., in the Proceedings of the American Philosophical Society, for November, 1878; and in the Bulletin of the U. S. Geological Survey of the Territories for February, 1879. In the latter article thirty-eight species of vertebrata were enumerated as having been discovered in the Truckee beds of the White River formation of Oregon, of which all but one were mammalia.

I have since conducted explorations in that region, the expeditions being mostly under the direction of Jacob L. Wortman. This gentleman has obtained a great many specimens, several of which indicate new species, which it is the object of the present article to describe. In addition to these discoveries, Mr. Wortman has sent remains of *Lacertilia* and *Ophidia*, orders previously unknown in Oregon. I had discovered them in the White River formation in Colorado in 1873.

HESPEROMYS NEMATODON, sp. nov.

This rat is represented by a beautiful skull, discovered by Prof. Thomas Condon, of Eugene city, and by several jaws, and other fragments subsequently found by Mr. Wortman.

The frontal region is not contracted as in *Eumys elegans* and *Fiber zibethicus*, but the superciliary ridges are well separated from each other, as in *Hesperomys americanus*. The frontal and posterior nasal regions are slightly concave in transverse section. The molars display tubercles on one side, and crescents on the other, the former being external in the superior series. The first superior molar has an additional tubercle at its anterior extremity. The incisors have a transverse anterior face, which is divided by several delicate ridges.

Length of superior molar series, .0065; length of first superior molar, .0028; interorbital width, .0042. Length of inferior molar series (specimen No. 2), .0064; length of first molar, .002; width of incisor, .001; depth of ramus at second molar, .004.

SCIURUS VORTMANI, sp. nov.

Like the *S. relictus*, of the Colorado White River beds, this is a rare species, being only represented by a mandibular ramus in my collection. This part is remarkable for its depth as compared with its length; and the base of the coronoid process has an anterior position. It rises opposite the posterior part of the third molar, and its anterior border descends to a point just below the posterior part of the first molar. The inferior border of the masseteric fossa is a prominent edge, which descends below the inner inferior margin of the ramus. The molars diminish regularly in size forwards; their crowns are basin-shaped, with the anterior angle of the ex-

ternal border elevated, and the inner border notched medially. Incisor compressed.

Length of inferior molar series, .010; antero-posterior diameter of first molar, .0024; length of fourth molar, .003; depth of ramus at diastema, .0055; depth at third molar, .0095.

This species is considerably larger than the *S. relictus*. It is dedicated to Jacob L. Wortman, of Eugene, Oregon, a successful explorer of the paleontology of that State.

PACICULUS INSOLITUS, gen. et sp. nov.

Char. gen. Superior molars three, rooted. Enamel forming three entrant loops on the external face of the crown, and one on the internal face.

While the number of the superior molars of *Paciculus* is as in the *Muridæ*, the details of their structure is much as in *Dasyprocta* and *Steneofiber*. But one species is known.

Char. spec. Size small. Molars regularly and rapidly diminishing in size posteriorly. Inner enamel loop turned forwards; the external straight and transverse, excepting in the first molar, where the anterior column of the tooth is extended forwards, and the anterior loop is turned backwards.

Length of superior molar series, .006; length of first molar, .0021; width of first molar, .0018; length of third molar, .001.

CANIS LEMUR, sp. nov.

This species is represented by several crania in my possession. It is the smallest of the genus yet discovered in the Miocene formation of Oregon. It is characterized by the contracted proportions of the muzzle, the width of the front, and the large size of the eyes. The postorbital process is only a short angle. The superior border of the temporal fossa is traceable from the postorbital process. Those of opposite sides embrace a smooth sagittal area of an elongate urceolate form, and unite posteriorly in a very short crest. The species is further characterized by the large size of the first superior tubercular molar, which with the second, has a distinct inner cingular border, and median tubercle. The superior sectorial is short, and its inner cusp is anterior.

Some mandibles probably belonging to this species exhibit posterior cutting lobes on the third and fourth premolars. The blades of the sectorial are very short, and the heel large and wide. The tubercles of the tubercular are large.

Length of cranium to front border of orbit, M. .0525; elevation of occiput, .058; length of superior sectorial, .007; length of first tubercular, .0058; width of first tubercular, .0078; width of second tubercular, .005; length of second tubercular, .0035; interorbital width of second specimen, .0056; length of inferior dental series, .048; length of sectorial, .008; length of heel of sectorial, .0035; length of inferior tubercular, .055; depth of ramus at sectorial, .0105.

This species is smaller than *Canis gregarius*, and differs from both it and the C. *cuspigerus* in the larger orbits, more contracted muzzle, and in the distinct superior border of the temporal fossa, etc.

The dog which I referred to the genus *Enhydrocyon* (Cope) under the name of *E. basilatus*, probably belongs to another genus. Portions of the maxillary bone present the dentition of *Icticyon*, viz., P-m. 4, M. 1, thus differing from *Enhydrocyon*, which possesses P-m. 3; M. 2. As there are but three premolars in the inferior series, this species cannot be referred to *Icticyon*, but must be accepted as typical of a new genus. This I propose to call *Hyænocyon*. It resembles *Hyæna* more nearly than any genus yet discovered in North America, but probably belongs to the *Canidæ*.

AMPHICYON ENTOPTYCHI, sp. nov.

This rather small species is represented by a skull which lacks the extremity of the muzzle and the mandible, and has its parietal region crushed.

The superior premolar teeth are rather short in anteroposterior diameter, while the tubercular molars are relatively large. There are no posterior lobes on the former; the internal and external cingula are well developed in the first and second of the latter. The third tubercular is about as wide as the second is long. The sagittal crest is only distinct on the posterior part of the parietal region. Estimated length of skull, M. .110; length of superior molar series, .041; length of true molar series, .016; length of first tubercular, .0075; length of second tubercular, .055; width of second tubercular, .0074; length of third tubercular, .0036; width of third tubercular, .052: Length of sectorial width between anterior external angles of first tuberculars, .030.

The teeth of this species are about half the size of those of *A. vetus* Leidy.

ARCHÆLURUS DEBILIS Cope.

American Naturalist, 1879, p. 798*a*, December.

Char. gen. Dentition, I. $\frac{3}{3}$; C. $\frac{1}{1}$; P-m. $\frac{4}{4}$; M. $\frac{1}{1}$; mandible with the anterior face of the symphysis separated from the lateral face by an angle which is not produced downwards. Superior sectorial without anterior lobe; inferior sectorial with heel. The characters place *Archælurus* at the base of the *Felidæ*, showing that it is the most generalized form yet known, and about equally related to the feline and Machærodont series.

Char. specif. General structure of the jaws weak. Superior canine small, little compressed, with an acute posterior edge which is not serrulate. First premolar in each jaw one-rooted; second inferior premolar large; sectorials large, diastemata very short. Alveolar border below the inferior sectorial and tubercular teeth everted, forming a large osseous callus, which has a free inferior and posterior margin, the latter rising into the base of the coronoid process. Zygomata slender; postorbital processes little prominent; front wide, convex transversely.

Length of cranium, M. .200; superciliary width, .052; zygomatic width, .124; length from orbit to superior incisors, .066; length of superior sectorial, .023; length of inferior molar series, .064; diameter of superior canine, .012. About the size of the panther, or of the *Nimravus brachyops*.

The osseous callus below the true molars is a remarkable character, unique in the order of *Carnivora*. It is evidently a provision against the weakness of the mandibular rami, at the point of greatest strain.

HOPLOPHONEUS PLATYCOPIS Cope.

American Naturalist, 1879, p. 798*b*, December.

This is the largest sabre tooth discovered in North America. It was twice the bulk of the *H. primævus* Leidy, and differs from that species and the *H. occidentalis* in the relatively larger size of the premolar teeth, which are less obliquely placed than in the latter. The first superior premolar is very small. The canine is large and compressed as in the species of *Machærodus*, and has serrulate posterior and anterior cutting edges. Inferior incisors with conic crowns. The symphysis is very deep in consequence of the large development of the inferior flares for the canines. Sagittal crest making a steep angle with the front.

Total length of cranium, M., .280; zygomatic width, .192; length from orbit to superior incisors, .095; length of inferior sectorial, .025; of inferior sectorial, .022; length of inferior molar series, .055; length of crown of superior canine, .060; width of superior canine at base, .026. This skull is less than one-sixth smaller than that of the Bengal tiger (*Uncia tigris*).

CHÆNOHYUS DECEDENS, gen. et sp. nov.

The characters of this genus will be best understood by comparison with those of the two other genera of suilline animals which occur in the same formations.

Premolars three, a wide diastema between the anterior one and its successor..... *Chænohyus.*
Premolars four; diastemata before and behind the first... *Thinohyus.*
Premolars four, in a continuous series..... *Palæochærus.*

It is then apparent that *Chænohyus* differs from *Dicotyles* in having the diastema behind the anterior premolar instead of in front of it.

Char. spec. This hog is represented in the collection of Prof. Condon at Eugene City, Oregon, by the anterior part of a cranium, which includes both maxillary bones. Its size is a little less than that of the *Dicotyles torquatus*. The series of maxillary teeth is slightly convex externally, and the teeth diminish rapidly in size anteriorly. The difference in dimensions between the first and last true molars is much greater than in the other suillines of this period known to me. The external tubercles of the true molars are somewhat flattened externally, and a distinct cingulum passes entirely round their external bases. The first superior premolar has one root, the other premolars possess two.

I suspect that the *Dicotyles hesperius* of Marsh belongs to *Chænohyus*. It differs from the *C. decedens* in its materially smaller size. According to Marsh, it is considerably smaller than his *Thinohyus socialis*, which is about as large as the *C. decedens*.

Discovered by Prof. Condon in the region of the John Day river.

THINOHYUS TRICHÆNUS, sp. nov.

Represented by the greater part of the maxillary and mandibular bones of both sides, with teeth.

There is a diastema behind the second inferior premolar, about equal in extent to that in front of it, which is twice as wide as the one in front of the first premolar. The first and second premolars have but one root, while the two others have two. The first superior premolar is close to the canine, and has but one root; it is separated by a diastema from the second. The latter has one root, and is near the third, which has two roots. The third and fourth superior premolars have each one compressed external, and one internal lobe. That of the third is lower and is pressed against the external. It is continued as a ridge posteriorly, enclosing a shallow basin with the external tubercle.

The true molars of both jaws have the intermediate tubercles well developed. The external tubercles of the superior molars are not flattened, and have a low cingulum surrounding their bases. Surface of enamel nearly smooth. Length of true molar series of upper jaw, M. .046; of last superior molar, .017; width of do., .013. Diameter of first true molar,—anteroposterior, .012; transverse, .011. Length of posterior three premolars along base, .028; of diastema, .011. Length from inferior canine to third inferior premolar, .028; length of diastema anterior to second premolar, .008; do. of diastema posterior to second premolar, .007.

This is the species I formerly called *Palæochœrus condoni** Marsh (*Platygonus* Marsh). That species belongs to the Loup Fork fauna, and not to the present one. Some teeth which probably pertain to it in Prof. Condon's collection, exhibit the peculiarity of not possessing any basal cingula on the molars of either jaw.

From the fact that Pomel† implies that some of the species of *Palæochœrus* present a diastema, I have referred the *Thinohyus* of Marsh to it as a synonym.‡ Pomel's genus was, however, established on a species (*P. typus*) which has no diastema, hence *Thinohyus* is probably to be preserved.

This species is about the size of the *Thinohyus lentus* of Marsh, and agrees with his descriptions in several respects. There appears, however, to be a material difference between the specimens in the relations of the inferior premolars. Marsh describes a much more considerable diastema in front of the first premolar, and does not mention the one behind the second premolar. I am acquainted with a second species of the genus of about the same size, in which there are but two diastemata, viz., one before and one behind the first premolar, and I suppose this one to resemble the *T. lentus*. Specimens of this character are in my collection, and I have seen one in that of Prof. Condon.

PALÆOCHŒRUS SUBÆQUÀNS, sp. nov.

This suilline is represented by an entire cranium which was discovered by Prof. Condon. It indicates a species of the size of the *Dicotyles torquatus*, and smaller than the *Thinohyus trichænus*.

The first true molar is not disproportionately smaller than the third; and

* Bull. U. S. Geol. Surv. Terrs., 1879, V, p. 58.

† Catal. Vertebr. Foss. Basin Loire, 1853, p. 86.

‡ Bull. U. S. Geol. Surv. Terrs., 1879, V, p. 44.

there is a distinct cingulum at the external base of the superior true molars. The external faces of the external tubercles of these teeth are somewhat flattened. The first premolar has one root, the others have two. They are equidistant and not very closely crowded.

Several suillines are described by Marsh and Leidy, either imperfectly or from imperfect material, so that I have had some difficulty in determining my specimens. The *D. hesperius* of Marsh is probably, as above observed, a *Chænohyus*. I have specimens agreeing with Marsh's description of *Thinohyus socialis*. They belong to an animal of the size of the *Chænohyus decedens*, but the superior molars have no basal cingulum. Its generic position is yet uncertain. Other specimens agree in characters with the *Dicotyles pristinus* of Leidy, with which *Thinohyus lentus* of Marsh agrees in size. In this hog there is no diastema in front of the third inferior premolar, so that it is clearly distinct from the *Thinohyus trichænus* of the present paper.

MERYCOPATER GUIOTIANUS Cope.

Having obtained several crania of this species, I can give the characters of the genus *Merycopater** more fully than hitherto. Dentition; I. $\frac{1-2}{3}$; C. $\frac{1}{1}$; P-m. $\frac{4}{4}$; M. $\frac{3}{3}$. A diastema above and below; fourth superior premolar with two external crescents; fourth inferior premolar identical in form with first true molar; the first inferior premolar functionally the canine. Orbit open posteriorly; no facial fossæ or vacuities.

This genus is *Agriochærus*, with a considerable diastema, and very much reduced superior premaxillary teeth. In my best preserved cranium there is no alveolus for the first; that of the second is rudimental, and that of the third is small. The premaxillary bones are very small and distinct from each other. The enlargement of the cingula represents the posterior internal tubercle of the fourth superior premolar, so distinct in *Coloreodon*.

The deficiency in superior incisors is an interesting approximation to true ruminants not heretofore observed in *Oreodontidæ*. I have found the inferior incisors deficient in the genera *Cyclopidius* and *Pithecistes*.

COLOREODON FEROX, gen. et sp. nov.

Char. gen. Dentition, I. ?; C. ^{1}; P-m. ^{3}; M. ^{3}; a wide diastema above; the first inferior premolar functionally the canine. Last superior premolars with two external and two internal crests Orbit open posteriorly; no facial fossæ or vacuities. The genus differs from *Agriochærus* in the wide diastemata, presence of but three superior premolars, and two inner tubercles of the fourth premolar.

I possess two species of this new genus, which are represented in my collection by crania without premaxillary bones and mandibles.

Char. specif. Size of *Oreodon culbertsoni*. Maxillary bone excavated above the diastema, the superior border of the concavity extending nearly to the base of the zygoma. Zygomatic arches expanded, their external face concave below the orbit, and plane posteriorly. Saggittal crest very

* Cope, *American Naturalist*, 1879, p. 197.

high, dividing anteriorly into two ridges, which diverge widely, and terminate at a point opposite the postfrontal process. The space enclosed in their angle is plane. Space between supraorbital foramina convex.

The posterior internal tubercle of the fourth premolar is much smaller than the anterior; the inner basal tubercles of the second and third are subposterior and acute. The length of the diastema is equal to that of the premolar series. The enamel of the molars is wrinkled. The canines are robust.

Estimated length of skull, M. .200; length of superior molar series, .066; of diastema, .028; diameters of second true molar, — anteroposterior, .016, transverse, .017; width of palate at do., .033; interorbital width, .060.

The strongly developed crests and wide zygomata of this animal, together with the large canine teeth, evidently indicate that it was a formidable antagonist even for the *Carnivora* of its time.

Discovered by Charles H. Sternberg.

COLOREODON MACROCEPHALUS, sp. nov.

This Oreodont is considerably larger than the *C. ferox*, being of the size of the *Eucrotaphus major*, while the former equals the *Oreodon culbertsoni*. It also differs from its congener in the relatively longer and narrower frontal region. The sagittal crest is elevated, and divided into two crests opposite the posterior part of the zygomatic fossa. These branches are nearly straight, and diverge at an acute angle, terminating above the postorbital processes. They enclose a deep concavity, which is continuous with the front anteriorly. In *C. ferox* these crests diverge much more abruptly and widely from a more anterior point, and enclose a much smaller concavity. The supraorbital foramina are close together and are separated by a small protuberance of the middle line. The parietal walls of the temporal fossa are rugose. The posterior tubercle of the fourth premolar is well developed, while a single tubercle is present on the preceding premolar.

Length of cranium from inion to above superior canine. M. .230; length from superior canine postorbital angle (axial), .124; length from junction of crests to supraorbital foramina, .060; interorbital width, .072; length of bases of the molars except the last, .050; length of three premolars .027. Length of diastema, .030.

From the North Fork of John Day River; found by J. L. Wortman.

Stated Meeting, December 19, 1879.

Present, 10 members.

Vice-President, Mr. FRALEY, in the Chair.

A letter of acknowledgment and envoy was received from the Linnæan Society, London, Oct. 20 (99, 100, 101; XV, 2).

Letters of envoy were received from the Batavian Society of Arts and Sciences, Feb. 23, 1877, and April 15, 1878; from the Royal Observatory, Brussels, April, 1879; from the Bunker Hill Monument Association, Boston; and from the Society of Geography and Statistics, Mexico, Nov. 17, 1879.

A letter requesting cabinet exchanges was received from the Bridgeport Scientific Society, Conn., Nov. 20, 1879.

Donations for the Library were received from the Asiatic Society of Japan; Royal Society, Victoria; Batavian Society, Batavia; M. Joachim Barrande, Prag; the Academies at Berlin, Munich, Brussels, and Philadelphia; the German Geological Society; Zoologische Anzeiger, Leipsig; Societies at Bonn, St. Gall, Cherbourg, Cambridge (England); the Commercial Geographical Society at Bordeaux; Geographical and Statistical Society, Mexico; Geographical Society, Paris; Geological, Geographical, Zoological, Linnæan, and Antiquarian Societies, Victoria Institute and Nature, in London; Dumfrieshire and Galloway A. N. H. Society; Bunker Hill Monument Association and Natural History Society, Boston; Silliman's Journal; Brooklyn Entomological Society; Journal of Pharmacy, Medical News, and Mr. Henry Phillips, Jr., Philadelphia; Peabody Institute, Baltimore; Smithsonian Institution; Milwaukee Public Library; and National Museum, Mexico.

A bronze medal for the cabinet was received from the

Batavian Society, with the inscription:—SOCIETAS . ART . SCIENT . BAT . IN . MEMORIAM . I . SAEC . FEL . CLAUSI . in a wreath, and around the margin A.P. VIII . X . MAI . MDCCLXXVIII—MDCCCLXXLVIII . ——— On the reverse, a palm, labeled on its trunk ‡; mountains in the background; marginal legend: TEN NUTTE VAN'T GEMEEN BATAVIA'S GENOOTSCHAP.

Mr. Chase communicated a note on the Sun's apparent diameter and the nebular origin of the terrestrial day.

Dr. Horn communicated two papers: 1. "A monographic revision of the species of *Cremastochilus* of the United States;" 2. "A Synopsis of the *Euphoridæ* of the United States." With one plate.

Mr. Hale gave an interesting verbal account of his acquaintance with the various Indian tribes collected on the Canadian reservation at Brantford, east of London, Upper Canada; of the most distinguished surviving chief of the Six Nations, Sakayenkwaraton (disappearing mist), known to the English as John S. (smoke) Johnson, now 87 years old. His son, Chief George Johnson, bears the official title of the one of the original 50 council chiefs whom he represents.

Mr. Hale described the formation of the confederation, three centuries ago, and testified to the accuracy of Mr. Morgan's history of it.

He then described the *Book of Rites*, which after two centuries of verbal tradition was reduced to writing by some one connected with the early missions. Two copies exist, and Mr. Hale is obtaining a translation of it. It is the only known American aboriginal piece of literature, north of Mexico. It has many archaic words, and is engrossed, in an old-fashioned current English hand, in a common schoolboy's copy book.

He then described the Wampum belts of the confederation, partly preserved by the Onondagas in New York, and partly among the Indians in Canada.

He also told of his discovery that the Tutelos were not an Iroquois tribe, but were allied to the Dakotahs or Sioux of

the West. Their first seat was in North Carolina. Brainard reported that Tutelos, Iroquois and Delawares lived together at Shamokin, Pa., speaking three entirely different languages. The syntactical position of the personal pronoun before, after, or between any two syllables of the verb allies the Tutelo language with the two dialects of the Dahcotah, and separates it from all the other Indian dialects. But Tutelo seems to be older than the Dahcotah. So also Huron (Quebec) was older than Iroquois (Six Nations); and Delaware older than Chippeway. It looks as if the movement was from east to west, and not from west to east.

Repeated questions from the members present elicited many curious and interesting personal details from Mr. Hale, who hopes to have before long a memoir ready for publication.

Pending nominations 885 to 892, were read.

The Minutes of a special meeting of the Board of Officers and Members in Council were read, and the claim for the Magellanic premium was referred to the Committee appointed at the last meeting of the Society.

The Report of the Trustees of the Building Fund was read, dated December 16, 1879, by which it appeared that the receipts since January 30, 1877, had amounted to $2882.04; and that the Fund now consists of assets to the value of $12,586.50. Signed, Benj. V. Marsh, Treasurer; Eli K. Price, F. Fraley, auditors of the Finance Committee.

The Report of the Finance Committee was read, and the appropriations for the expenses of the ensuing year, recommended in the report, were on motion, ordered.

And the meeting was adjourned.

Astronomical Approximations. I. Apparent Semi-diameter of the Sun, and Nebular Origin of the Terrestrial Day. By Pliny Earle Chase, LL.D., Professor of Philosophy in Haverford College.

(*Read before the American Philosophical Society, Dec.* 19, 1879.)

The various mathematical deductions which I have drawn from the nebular hypothesis, as modified by Herschel's theory of "subsidence," furnish many independent tests for judging of the probable accuracy of delicate and difficult astronomical observations. The consistency of the tests may be shown by examples, one of which is given in the present note.

The hypothesis that the solar system has been shaped by undulations, moving with the velocity of light, leads to the following equation:

$$\left(\frac{1 \text{ year}}{1 \text{ day}}\right)^3 = \frac{\pi^2}{2} \times \left(\frac{\text{Earth's distance}}{\text{Sun's semi-diameter}}\right)^3$$

From this equation we find, for Earth's mean distance from Sun, 214.54 solar semi-diameters; and for Sun's apparent diameter, 32′ 2″.85. The accordance of this result with observations is as follows:

	Distance.	Diameter.
Newcomb,	214.86	32′ 0″
Chase,	214.54	32 2.85
Fuhg,	214.52	32 2.99
British Naut. Almanac,	214.45	32 3.64
American " "	214.41	32 4
Lockyer,	214.39	32 4.205

Dr. Fuhg's estimate, which approximates most closely to my own, is deduced from 6827 measurements.* Notwithstanding the vast labor which is represented by those measurements and their subsequent discussion, I cannot but believe that my own result is still more accurate. For it involves no careful micrometry, no allowance for irradiation, and no other elements of possible uncertainty than small fractions of a second, in the estimated lengths of the sidereal year and of the mean solar day.

This result may, perhaps, be rightly regarded as an *experimentum crucis*. Therefore, to avoid the trouble of referring to the papers in which I have established the data for my formula, I will repeat the fundamental considerations on which it rests.

Any body, revolving in a circular orbit, under the influence of a central force g, which varies inversely as the square of the distance, would acquire the velocity of revolution $(\sqrt{gr})$, in the time of describing an arc equivalent to radius. It would acquire a parabolic velocity $\sqrt{2gr}$, in $\frac{1}{\pi\sqrt{2}}$ of a revolution, and it would acquire $\frac{\pi}{\sqrt{2}}$ times the parabolic velocity in a half revolution, provided all the increments of the central

*Astron. Nachrichten, 2040, cited in *Am. Journ. Sci.* for Aug. 1875, p. 97.

force were retained. The parabolic velocity is the limit between the tendencies to incipient aggregation and to complete dissociation, in the subsidence of dense nebulous particles.

In a body which is both revolving about the centre of a system and rotating on its own axis, every particle is subject, during each half-rotation, to cyclical variations in the systematic stress, which are antagonized by the constant central force of the body itself.

In a condensing or expanding nebula, the time of rotation varies as the square of radius. At any given instant, the squares of the velocities, or the living forces of different rotating particles, are proportioned to the squares of their radii, or to the times of nebular rotation and synchronous revolution when condensed to their respective positions.

If the velocity of synchronous rotation and revolution is determined by the aggregate resistances of the central force of the nucleus, to cyclical variations of stress which may be represented by a wave-velocity, while the velocity of rotation of a detached planet is determined by a force which may be represented by an incipiently aggregating or parabolic velocity, the representative parabolic velocity of the nucleus may be found by taking $\frac{\sqrt{2}}{\pi} gt$; g representing the force of gravity at any past, present, or future equatorial limit of the nebula, or Laplace's limit of possible rotating atmosphere, and t being $\frac{1}{2}$ the corresponding time of synchronous rotation and revolution. I have already shown that gt, in the solar system, is *the velocity of light.*

Let a represent the time of synchronous rotation and revolution when Sun's surface should contract so that Laplace's limit would correspond with its present equatorial radius; β, a mean solar day; γ, Earth's mean distance ÷ Sun's radius; δ, a sidereal year. Then $a = \delta \div \gamma^{\frac{3}{2}}$; tang. Sun's apparent semi-diameter $= \frac{1}{\gamma}$.

According to Leverrier and Hansen, Earth's present aphelion, or limit of incipient condensation, is at 1.016771 rad. vec. This corresponds, within $\frac{1}{100}$ of one per cent., to Stockwell's determination of the centre of the belt of greatest condensation.* The relations between the primitive solar and terrestrial centres are thus simplified, so that the foregoing considerations lead us at once to the following equations:

$$\left(\frac{\delta}{\beta}\right)^3 = \frac{\pi^2}{2}\gamma^3$$

$$\frac{\delta}{\beta} = \frac{\pi^2}{2}\left(\frac{\beta}{a}\right)^2$$

*The arithmetical mean between Mercury's secular perihelion (.2974307) and Mars's secular aphelion (1.7363254) is 1.016878.

A Monographic Revision of the Species of CREMASTOCHILUS *of the United States.*

BY GEORGE H. HORN, M.D.

(*Read before the American Philosophical Society, Dec.* 19, 1879.)

In the Trans. Amer. Ent. Soc. 1871, p. 339, et. seq., will be found a table prepared by me of the species then known, after a short study, the object of which was to present some means for their identification in a ready manner, the descriptions being scattered in books, inaccessible to many, and sometimes unintelligible, either from their brevity or want of appreciation of characters which have since come to be of greater value. The above mentioned table was made use of by Prof. Westwood (in his "Thesaurus Oxoniensis," p. 58), who at the same time described a certain number of supposed new species, since which others have been described by Dr. LeConte, so that the aggregate assumed quite formidable dimensions for a genus so peculiar.

The types from which Prof. Westwood's descriptions were made are for the most part in the Royal Museum of Berlin, where I had the opportunity of examining them, through the kindness of the curator in charge. The descriptions appeared soon after my examination had been made, and left nothing to be desired for their identification.

Having had occasion to study the species more closely, I have seen no reason for any great alteration of the table already given, further than to add the new species and transpose one which seemed rather out of place. The accompanying table is, however, made so full as to contain nearly all the important characters of each species, so that the chances of a mistake in identification are reduced as near as possible to the minimum.

Before proceeding to the table it seems proper that the characters should receive more extended notice and comparison, which can be accomplished by considering the different members in order.

The head is short, oval, rather deeply inserted in the thorax, the vertex usually convex, the clypeus more suddenly deflexed, forming an angle with the front. In *planatus* and *saucius* the head is more exsert and presents in each characters worthy of special observation, these are—the carina on the middle of the clypeus common to both species, the supraorbital carinæ of the first and the sudden narrowing of the head behind the eyes in the second. In neither species is there an obtuse ridge indicating the limits of the clypeus and front, but the upper surface of the head is gradually declivous in *planatus* and very convex in *saucius*. In *pilosicollis, crinitus* and *Knochii* the front is rather flat and the limit between it and the clypeus is indicated by an obtuse arcuate ridge, so that the clypeus seems suddenly deflexed from the front. In *leucosticlus* the front and clypeus are on the same plane, nearly flat, while all the other species not already mentioned have the front convex but to a variable degree.

The clypeus normally is not broader than the head, the margin reflexed, the anterior edge more or less arcuate, the angles rounded. In two species the clypeus is wider than the head, in *Wheeleri* conspicuously so with the angles rather acute, in *crinitus* less dilated with the angles rounded. The anterior margin is rather widely reflexed and is useful in aiding the species in their fossorial tendencies.

The mentum presents important modifications, the simplest being that of *leucostictus* or *saucius*, in which the face is quite flat and the margins narrowly reflexed. From this form the mentum becomes more concave and the sides more widely reflexed so that it becomes cupuliform. Those species with the mentum least concave have the posterior margin entire, as the concavity increases we find a slight notch, which in the last four species becomes a rather wide and deep excision semicircular at bottom. These modifications of the mentum form a very natural means of dividing the species.

The thorax is so modified in form and structure in all the species, that nearly all can be separated by it alone. The simplest form is that of *leucostictus* which resembles that of Trichius; apex feebly emarginate, sides feebly subangulate, hind angles rounded, the margin acute posteriorly, there is no incisure about the front angles nor are there any pubescent spots such as occur in every other species. In *planatus* the sides are subacutely margined, arcuate in front and gradually narrowed behind, not very unlike Iphthimus, in fact the species resembles a Tenebrionide when walking. The anterior angles are small, the notch or fovea within feeble, and there is a notch in the lateral margin which limits the angle. The hind angles are continuous with the margin, not very prominent and limited by an oblique groove within. The next modification in degree is in the *Schaumii* group, in which the thorax is broader and less depressed, the anterior angles are feeble, the fovea within them, but no lateral notch in the margin. In two of the species the hind angles are not limited by any groove and the anterior margin of the thorax beneath is not notched. In *angularis*, however, the hind angles have a limiting groove, and beneath the front angles is a slight incisure.

The three species following *angularis* do not present any very important modification of its type, the angles are nearly the same and there is the subangular incisure, but in *pilosicollis*, we observe a groove running outward from the fovea and limiting the anterior angles. This gives the first intimation of the tuberculiform angle which is observed further on.

In *nitens*, the front angles begin the nodiform structure by the greater depth of the transverse groove. The hind angles are also much retracted within the line of the sides, and the groove which limits them within is so deep that the angle is depressed below the surface of the disc of the thorax.

In passing to *variolosus*, the anterior angles become so completely surrounded by deep grooves as to become almost like isolated tubercles, and may be assumed to be the result of the gradual exaggeration of the various

grooves and incisures mentioned in the preceding forms. In *Harrisii* the anterior angles are rather broad and more obtuse than in any of the species described and the incisure beneath them is very feeble.

Of a totally different type of thorax we must consider *saucius* and *Wheeleri*, which require special mention. These have the disc of three parts, a central more depressed portion and the lateral more convex, which may be compared with Hetærius or Plegaderus. The division is best marked in *saucius*. The region of the anterior angles in this species presents a curious modification, in which the anterior angles appear to be auriculate, but this is really an extension upward and forward of the anterior margin or collar of the thorax, and corresponds in homology with that portion of the under side of the thorax of the other species which is below the incisure. The true anterior angle will be observed in the figure behind the auriculate process. The hind angles are spiniform, their structure will be observed in the figure. In *Wheeleri*, the tripartite character is less observable. The anterior angles do not depart much from the normal type, and the incisure beneath is well marked. The hind angles are broad but obtuse, and have a feeble trace of an oblique limiting groove. This species deserves mention as being the only one with the middle coxæ absolutely contiguous and the prosternum behind the coxæ slightly elevated.

The legs also vary to an important extent, and will be found described with each species. The tarsi follow the modifications of the legs, and, from being as long as the tibiæ, are reduced to even less than half that length in *Schaumii*. As a rule the shorter the tarsi the more compressed do they become, the only exception being in *leucostictus*, which with short tarsi has the upper side flat, so that the transverse section of a joint would be an isosceles triangle.

The distribution of the species in accordance with the form of the mentum is well known. Those with the mentum entire belong from the eastern base of the Rocky Mountains to the Pacific Coast, there being but one exception, *leucostictus*, from Maryland. Where the mentum is notched or deeply emarginate, the species belongs to the Atlantic fauna, most of them having a wide range of distribution, except in the case of *squamulosus*, which is limited to Georgia and Florida.

In the accompanying table and descriptions there is very rarely any mention made of the hairs of the surface. These exist to a greater or less extent on all the species, but are very easily removed and are therefore of uncertain value. So also with the spots of whitish exudation which I have observed to a greater or less extent on *leucostictus*, *pilosicollis*, *angularis*, *Schaumii*, *Westwoodi*, *canaliculatus*, and *castaneæ*. These have all been observed in ants' nests.

Mentum plate entire behind.

Anterior tarsi with last two joints thickened.

Clypeus carinate at middle, head with lateral carinæ above the eyes prolonged backward in obtuse processes.....**planatus** Lec.

Anterior tarsi not thickened, more slender at tip.
Disc of thorax trilobed.
Clypeus carinate at middle; tibiæ slender at base.....**saucius** Lec.
Clypeus not carinate, broader than the head; middle and posterior tibiæ broad and flat; middle coxæ contiguous...**Wheeleri** Lec.
Disc of thorax simple, not trilobed.
Hind angles of thorax rounded, the margin posteriorly acute; tarsi very short and flat above.....**leucostictus** Burm.
Hind angles of thorax more or less prominent.
Legs and tarsi short, the former decidedly fossorial, the latter much compressed.
Tarsi very short, less than half the tibiæ, hind angles continuous with the disc.....**Schaumii** Lec.
Tarsi longer than half the tibiæ.
Hind angles continuous with the disc.....**Westwoodi** Horn.
Hind angles limited by an oblique groove.....**angularis** Lec.
Legs ambulatorial, tarsi as long as the tibiæ.
Hind angles continuous with the side margin.
Front angles smooth, limited behind by a transverse impression.....**pilosicollis** Horn.
Front angles continuous with the disc, punctured.
Clypeus wider than the head.....**crinitus** Lec.
Clypeus not expanded.....**Knochii** Lec.
Hind angles strongly retracted. Surface shining...**nitens** Lec.
Mentum plate with a small acute incisure behind,
Hind angles of thorax much retracted, anterior angles prominent and distinct from the disc.....**variolosus** Kby.
Hind angles feebly retracted, anterior angles continuous with the disc..**squamulosus** Lec.
Mentum plate with a deep emargination at the middle of the posterior margin.
Disc of thorax coarsely and densely punctured. Surface opaque.
Anterior angles of thorax continuous with the disc.
Hind angles feebly retracted, continuous at the outer margin with the disc.....**canaliculatus** Kby.
Hind angles strongly retracted, depressed below the surface of the thorax.....**retractus** Lec.
Anterior angles separated from the disc by a transverse impression, hind angles feebly retracted but depressed beneath the surface of the disc. .....**castaneæ** Kn.
Disc of thorax sparsely and irregularly punctured.
Anterior angles short, obtuse, hind angles moderately retracted and slightly depressed.....**Harrisii** Kby.

In the above table *Wheeleri* is placed in the series with entire mentum, although that organ is usually, but not always incised posteriorly. It would be decidedly out of place anywhere else, when the aggregate of its construction is taken into account.

C. planatus Lec.

Elongate, black, sub-opaque. Head densely punctured, clypeus subtruncate in front, angles rounded, margin moderately reflexed, a short carina at middle, vertex above the eyes obtusely carinate, the carina prolonged backward in a pyramidal process, occiput deeply transversely impressed. Mentum plate transversely oval, pointed behind, the sides and posterior margin reflexed, the anterior margin thickened. Thorax broader than long, narrower at base, sides in front arcuate, posteriorly oblique, margin subacute, anterior angles nodiform, excavated in front, the concavity pubescent, posterior angles moderately prominent, smooth, limited within by a distinct groove, surface coarsely punctured and with a vague median groove. Elytra flat, the disc limited by an obtuse ridge, vaguely bicostate, and moderately closely sculptured with elongate punctures. Pygidium obtusely carinate surface with coarse ocellate punctures. Body beneath with very coarse punctures, less dense on the abdomen. Legs slender, moderately long, anterior tibiæ bidentate near the tip, the middle and posterior unispinose at middle, tarsi slender, at least as long as the tibiæ, the anterior with the last two joints suddenly thickened. Length, .66–.72 inch; 17–18 mm. Pl. iv., fig. 1.

This species is one of the most peculiar in the genus from the length of the legs and the structure of the anterior tarsi. The latter character is not sexual, the female possessing it to an extent as great if not greater than in the other sex.

With this species I have united *depressus* Horn, founded on a specimen in which the hind angles are wanting by accident or deformity.

Arizona, Dr. Irwin; southern coast-range of California, W. M. Gabb.

C. saucius Lec.

Castaneous or piceous, shining. Head sparsely punctured, widest at the eyes and rapidly narrowing behind them, clypeus oval in front, anterior margin broadly reflexed, at middle a strong carina, vertex convex without carinæ. Mentum flat, sides and posterior margin narrowly reflexed. Thorax broad, as wide as the elytra, surface of three parts, the middle less convex, and the sides more convex, forming a broad thickened border as in *Hetærius*, anterior angle auriculate, separated from the thickened margin by a deep fissure, sides moderately arcuate, near the hind angles suddenly sinuate, the angles acute, surface sparsely punctured. Elytra slightly narrowed posteriorly, moderately convex, disc at middle vaguely impressed, surface sculptured with short strigæ. Pygidium finely punctured. Body beneath very sparsely and rather finely punctured. Legs sub-fossorial, the femora broad and compressed, anterior tibiæ with the outer apical angle prolonged, and with a tooth at middle, middle and posterior tibiæ compressed, slender at base, gradually broader toward the tip, a spine at middle of outer mar-

gin ; tarsi slender and except the posterior as long as the tibiæ. Length 44–.52 inch ; 11–13 mm. Pl. iv, fig. 2.

A specimen which Mr. Ulke has loaned me is larger and darker in color than any other I have seen, its mentum is not pointed behind nor have the four posterior tibiæ the spine at middle, it, however, agrees in all other important particulars, and I take it to be an abnormal specimen, especially as there are three sets of claws on the left anterior tarsus, pl. iv, fig. 11. The trilobed form of the thorax is certainly a very remarkable character which at once suggests the similar structure of *Hetærius*.

Occurs in Kansas, Nebraska and Texas.

C. Wheeleri Lec.

Black, subopaque. Head sparsely obsoletely punctate, not narrowed behind the eyes, clypeus truncate or feebly bisinuate in front, wider between the anterior angles than the head, margin moderately reflexed, angles obtuse, vertex rather flat. Mentum transversely oval, pointed behind, very deeply cupuliform, lateral angles very prominent. Thorax transversely quadrate, broader at base, sides irregular, sometimes a little wider behind the middle than at base, anterior angles obtusely prominent, pubescent within, hind angles pyramidal, obtuse at tip, disc of thorax depressed, lateral third more convex, the former more densely punctured, the latter less so, the angles smooth. Elytra a little wider than the thorax, disc flattened, at sides gradually rounded, surface with elongate foveæ sparsely placed. Pygidium coarsely punctured. Prosternum behind the coxæ slightly elevated. Middle coxæ contiguous. Body beneath opaque, coarsely but sparsely punctured, abdomen with short yellowish hairs. Legs sub-fossorial. Anterior tibiæ bidentate near the tip, the apical tooth not much prolonged, middle and posterior tibiæ flattened, broad, very little narrowed at base, a small tooth at middle. Tarsi compressed, nearly as long as their respective tibiæ. Length .40–44 inch ; 10–11 mm. Pl. iv, fig. 3.

The mentum in some specimens is feebly notched as in *variolosus*, but in others less acute and entire, so that the present might be associated with that species. The division of the disc of the thorax into three parts, although less distinct than in *saucius*, seems to indicate some relation between them, although this is hardly supported by any other characters. The form of thorax recalls somewhat that of *Plegaderus*, and the hind tibiæ, *Psiloscelis*. The peculiar characters of this species are—the broad clypeus, the point of

prosternum slightly elevated behind, the middle coxæ contiguous.

Occurs in Nebraska, New Mexico and in Eldorado county, California.

C. leucostictus Burm.

Black, shining, elytra with whitish spots at the sides. Head sparsely punctate, clypeus subtruncate in front, not wider than the head, angles broadly rounded, anterior margin moderately reflexed, vertex and clypeus nearly continuous in the same plane. Mentum plate flat, smooth and shining form hexagonal, margins, except in front, narrowly reflexed. Thorax broader than long, apex feebly emarginate, base truncate, feebly emarginate at middle, sides subangulate in front of middle, in front of which they are straight, posteriorly arcuate, margin very acute posteriorly and feebly reflexed, anterior angles not prominent, posterior rounded, disc sparsely punctate at middle, a little more densely at the sides. Elytra feebly depressed, disc very vaguely bicostate, surface with small foveæ sparsely placed. Pygidium moderately densely punctured. Body beneath shining, sparsely punctured and without pubescence. Legs sub-fossorial. Anterior tibiæ bidentate externally, the upper tooth distant from the apical. Middle and posterior tibiæ moderately compressed, narrow at base, a moderately strong oblique ridge at middle. Tarsi short, scarcely as long as half the tibiæ, slightly compressed, the upper edge, however, broad and flat. Length .52 inch; 13 mm. Pl. iv, fig. 4.

I have seen but one ♀ specimen of this species, which is peculiar by the absence of prominent thoracic angles. The short tarsi cause this species to approach *Schaumii* and *angularis* in which also the mentum is feebly concave. The tarsi themselves are peculiar in their very flat upper side, so that in transverse section the joints are very distinctly triangular.

One specimen, Maryland, in the cabinet of Mr. Ulke, who kindly loaned it for study.

C. Schaumii Lec.

Black, subopaque, above with short, black, erect hairs, sparsely placed, beneath with longer hairs. Head moderately densely punctured, clypeus smoother, at middle arcuate, sides oblique. Mentum nearly flat, punctured at the sides, posterior margin alone reflexed. Thorax one-half broader than long, a little wider at base than apex, sides regularly arcuate, anterior angles feebly prominent, excavated and pubescent on the inner side, posterior angles continuous with the curve of the margin or very slightly excurved, triangular, smooth above and with silken pubescence beneath, disc of thorax slightly convex, densely, coarsely punctured. Elytra slightly flattened on the disc, at sides convex, surface with oblong foveæ, sparsely placed. Pygidium with coarse shallow punctures. Body

beneath coarsely punctured, abdomen less densely. Legs short, decidedly fossorial, femora short and broad, anterior tibiæ scarcely narrowed at base, near the apex feebly bidentate, middle and posterior tibiæ broad, scarcely narrower at base, compressed, outer margin unispinose near the middle. Tarsi short, compressed, gradually narrowed toward the end and scarcely as long as half the tibiæ. Length .60–.64 inch; 15–16 mm. Pl. iv, fig. 5.

This species is abundantly distinguished from all others in our fauna by the extremely short tarsi. The surface of the hind angles of the thorax is continuous with that of the disc, there being no limiting depression.

With this species must be united *crassipes* Westw. I have seen the type and know it to be identical with *Schaumii*, Prof. Westwood having mistaken the next species for the present.

Occurs in California, especially in the south, near San Diego.

C. Westwoodi, n. sp.

Similar to *Schaumii* in all its characters, except in the form of the tarsi. These are at least two-thirds the length of the tibiæ, compressed, but scarcely broader at base than at tip. The joints are moreover more loosely articulated and do not appear to be retracted the one within the other as in *Schaumii*. The body beneath and abdomen are more densely punctured. Length .60 inch; 15 mm.

Occurs in Owen's Valley, California, where it was not rare, being found usually in or near ants' nests.

C. angularis Lec.

Black, subopaque, very sparsely pubescent above and beneath. Head densely punctured, clypeus arcuate in front, lateral angles broadly arcuate. Mentum moderately concave, the entire margin narrowly reflexed. Thorax broader than long, sides moderately arcuate, anterior angles moderately prominent, excavated and pubescent within, and limited behind by a slight transverse impression, hind angles triangular, continuous with the lateral margin, smooth above, pubescent beneath and separated from the disc by an oblique impression, disc feebly convex, coarsely and deeply punctured, median line vaguely impressed. Elytra flattened on the disc, convex at the sides, surface with oval foveæ moderately closely placed. Pygidium coarsely and deeply punctured. Body beneath as in *Schaumii*. Legs decidedly fossorial, the tibiæ a little narrowed at base, tarsi about half the length of the tibiæ, strongly compressed, and gradually narrowed to tip. Length .56 inch; 14 mm.

This species is closely related to *Schaumii*, but is always smaller, and more elongate. The impression within the hind

angles gives them an aspect of being more prominent than in *Schaumii*. The tarsi are formed similarly to that species, but a little longer. The next species is also closely allied, but the legs lose their fossorial character and become ambulatorial.

This species is widely distributed in the Pacific region.

C. pilosicollis Horn.

Closely related to *angularis*, but usually flatter above, and, when recently captured, with longer hairs. The head and thorax do not differ especially, except that the transverse impression behind the anterior angles is more distinct, and the median line more marked. The legs are ambulatorial, the tibiæ slender at base. The tarsi are as long, or very nearly so, as the tibiæ, slender, compressed and scarcely wider at base. Length .40–.50 inch ; 10–13 mm.

Specimens recently captured have moderately long hair on the thorax, and the elytra have whitish spots arranged in irregular transverse strigæ, these characteristics are evanescent and are of no specific value. If the figure of the legs of *C. armatus* Walker be correct, the name should have priority over *pilosicollis* (see Westw. Thesaurus, pl. xiv, fig. 1).

Occurs in California, Nevada and Oregon.

C. crinitus Lec.

Black, opaque, body above clothed with long, yellowish hairs, which are, however deciduous. Head densely punctured, clypeus a little wider than the head, in front feebly arcuate, sides rounded, anterior margin broadly reflexed. Mentum plate smooth, transversely oval, pointed behind, at bottom flat, margins reflexed more widely at the sides. Thorax broader than long, between the basal angles wider than at apex, sides moderately arcuate, anterior angles moderately prominent in front, within foveate and pubescent, posterior angles triangular, smooth, limited within by an oblique impression, disc of thorax flat, a vague median line, surface very coarsely punctured. Elytra flat on the disc, very vaguely bicostate, surface coarsely foveate-punctate. Pygidium coarsely, sparsely punctate. Body beneath coarsely punctate, more shining. Legs ambulatorial, anterior tibiæ bidentate near the tip, middle and posterior slender at base, gradually broader to tip. Tarsi nearly as long as the tibiæ, compressed. Length .50 inch ; 12.5 mm. Pl. iv, fig. 6.

I have seen but one ♀ of this species. It is closely allied to *pilosicollis* and *Knochii*, but differs from both by the clypeus being wider than the head between the eyes. It differs also from the former by the absence of transverse

impression limiting the anterior angles, and from *Knochii* by its much more depressed form, coarser sculpture. The hind angles are continuous with the lateral margin as in the two species cited. The hairs of the upper surface, although few, are a marked feature, but as they are probably deciduous as in *pilosicollis*, too much value cannot be attached to them in a specific point of view.

Occurs in California or Utah, locality doubtful.

C. Knochii Lec.

Black, feebly shining. Head moderately densely punctured, front slightly concave on each side, clypeus arcuate in front, side rounded, anterior margin reflexed. Mentum plate flat at bottom, sides and posterior margin more widely reflexed. Thorax one-half wider than long, base not wider than apex, sides broadly arcuate, anterior angles feebly prominent, not limited behind by a line, and feebly pubescent within, posterior angles triangular, smooth, distinctly limited within by an oblique impression, disc of thorax usually moderately convex, at middle vaguely canaliculate, surface with coarse but not densely placed punctures. Elytra moderately convex, disc rarely depressed, surface with oval shallow foveæ not densely placed. Pygidium sparsely punctate. Legs as in *crinitus*, tarsi as long as the tibiæ, slender and feebly compressed. Length, .36–.52 inch; 9–13 mm.

This species exhibits a slight range of variation in the sculpture of the upper surface, the punctures at times being coarser and more closely placed. This usually occurs in those specimens with the disc of thorax and elytra flatter, causing them to resemble the preceding species. The median line of the thorax is always more distinctly impressed. In very fresh specimens the surface is sparsely clothed with very short yellowish hair.

The three preceding species form a small group among those with entire mentum, by the legs being ambulatorial, tarsi moderately long, the hind angles continuous with the side margin of thorax, and not retracted.

To this species should be referred the *crenicollis* of Westwood.

Occurs from Illinois westward to Utah.

C. nitens Lec.

Castaneous, moderately shining. Head coarsely and densely punctured, vertex convex, clypeus arcuate, angles broadly rounded, margin moderately reflexed. Mentum plate smooth and flat at bottom, sides and pos-

terior margin widely reflexed. Thorax one-half wider than long, base not wider than apex, sides rather broadly arcuate, margin crenate, anterior angles very little more prominent than the apical margin, pubescent on the inner side, limited within and posteriorly by a deep grove, posterior angles smooth, auriculate, retracted within the line of the sides, and much depressed below the level of the disc, surface moderately convex, shining, punctures coarse, sparsely and irregularly placed, leaving large smooth spaces. Elytra slightly convex on the disc, coarsely, deeply and closely punctured. Pygidium coarsely punctured. Body beneath shining, coarsely but irregularly punctured. Legs ambulatorial, anterior tibiæ bidentate near apex, the terminal tooth moderately prolonged, middle and posterior tibiæ stout. Tarsi as long as the tibiæ, feebly compressed. Length .44 inch ; 11 mm. Pl. iv, fig. 7.

This species is the only one at present known in which the mentum plate is acute behind without notch, and the hind angles of the thorax retracted within the line of the sides. The middle and posterior tibiæ are thicker or less compressed than in any species of this series. It seems to be the link between the groups with the entire mentum and those with that organ notched or emarginate posteriorly, these all having the hind angles more or less retracted.

Two specimens, western Kansas.

C. variolosus Kby.

Black, slightly shining. Head coarsely and densely punctured, vertex convex, clypeus arcuate, margin reflexed. Mentum plate deeply concave, shining, posterior margin acutely notched. Thorax more than half wider than long, sides moderately arcuate and gradually wider behind, very suddenly and rather deeply constricted in front of the hind angles, anterior angles smooth, tuberculiform, completely surrounded by a deep groove, hind angles smooth, somewhat triangular, projecting laterally and separated from the disc by a deep impression, disc of thorax slightly convex, coarsely and densely punctured. Elytra flattened on the disc, surface with shallow oblong foveæ, somewhat confluent. Pygidium coarsely punctured. Body beneath very coarsely but rather sparsely punctate. Legs as in *squamulosus*. Length .36 inch ; 9 mm. Pl. iv, fig. 8.

This species is abundantly distinguished from the preceding by the thoracic characters, the anterior angles being more completely surrounded by a groove than in any other species, in our fauna. In some specimens the median line of the thorax is feebly impressed.

Synonymous with this species are *cicatricosus* and *Percheroni* Westw.

Occurs in the Middle States region.

C. squamulosus Lec.

Brownish or piceous, moderately shining, sparsely clothed with very short inconspicuous pubescence. Head coarsely and densely punctured, vertex convex, clypeus arcuate in front, sides broadly rounded, margin reflexed. Mentum plate deeply concave, posterior margin acutely incised. Thorax broader than long, sides rather irregular, usually diverging at apical third, then parallel at middle, in front of hind angles suddenly but not greatly narrowed, anterior angles scarcely more prominent than the margin, nodiform, smooth, limited within by a rather deep depression and posteriorly with a very faint groove, hind angles triangular, not very prominent, feebly punctate and separated from the disc by a deep oblique impression, disc of thorax slightly convex, coarsely and very regularly punctate. Elytra slightly convex, surface coarsely, deeply and rather closely punctate. Pygidium coarsely and densely punctate. Body beneath coarsely but not closely punctate. Legs ambulatorial, tibiæ stout, the anterior bidentate near the tip, the middle and posterior with a slight oblique ridge at middle. Tarsi as long as the tibiæ, rather slender and feebly compressed. Length .36–.40 inch ; 9–10 mm.

The notch in the margin of the mentum plate varies in extent, sometimes being very slight, but usually extending through the reflexed edge.

With this species must be united *junior* Westw.

Occurs in Georgia and Florida.

C. canaliculatus Kby.

Black, feebly shining. Head densely punctured, front convex, clypeus arcuate in front, lateral angles broadly rounded, margin reflexed. Mentum plate deeply concave, side and posterior margin very widely reflexed, deeply emarginate posteriorly. Thorax one-third wider than long, sides moderately arcuate and slightly coarctate in front of the hind angles, anterior angles obtuse, feebly prominent, limited within by a deep fovea, surface continuous with the disc and punctured, hind angles triangular, punctured, tip slightly turned outward, limited by a moderately deep groove, but not depressed below the surface of the disc, disc slightly convex, coarsely and densely punctured. Elytra flattened on the disc, vaguely grooved, and with shallow foveæ moderately densely placed. Pygidium coarsely and densely punctured. Body beneath densely and coarsely punctured, abdomen less densely. Legs as in *nitens*. Length .50 inch ; 12.5 mm.

This species is known from *castaneæ* by the hind angles being much less retracted and not depressed below the disc, as well as by the form of the anterior angles.

Occurs in Canada, Georgia and Illinois.

C. retractus Lec.

Resembles very closely the preceding species in form and sculpture, and

differs in the following characters: Disc of thorax more convex, hind angles much retracted, separated from the surface of the thorax by a deep impression, and depressed beneath it. Length .44–.48 inch; 11–12 mm. Plate iv, fig. 10.

The characters separating this species from *canaliculatus* are those in which it agrees with *castaneæ* from which the form of the anterior angles will distinguish it, the present species having the front angles of the first and the hind angles of the second.

Two specimens, Iowa and Texas.

Synonymous with this is *Walshii* Westw.

C. castaneæ Knoch.

Piceous, feebly shining. Head coarsely and densely punctured, front convex, clypeus arcuate in front, sides broadly rounded, margin reflexed. Mentum plate deeply cupped, the margin widely reflexed except in front, hind margin deeply emarginate. Thorax nearly twice as wide as long, sides moderately arcuate and slightly coarctate in front of the hind angles, anterior angles tuberculiform, limited within by the usual deep foveæ and posteriorly by an impressed line, hind angles triangular punctured at base, tips turned outward, separated completely from the surface of the disc by a deep impression, disc moderately convex, coarsely and closely punctured, median line sometimes feebly impressed. Elytra moderately flat, surface with large shallow foveæ. Pygidium very coarsely punctured. Body beneath coarsely and sparsely punctured, abdomen with very few punctures. Legs as in *nitens*, but with the tibiæ a little less thickened. Length .40 inch; 10 mm.

This species is known among those of the present group by the nodiform front angles which are separated from the disc by the transverse impression, the hind angles are also completely surrounded by a groove, and become depressed below the level of the disc.

C. Lecontei Westw. is merely a feeble form of this species, and is found in the more western regions.

Occurs in the Middle States region, extending westward to Colorado.

C. Harrisii Kby.

Piceous, moderately shining. Head very coarsely and deeply punctured, front convex, clypeus arcuate, angles broadly rounded, margin reflexed. Mentum plate deeply concave, margins reflexed, more strongly at the sides and posteriorly, the posterior margin rather broadly and deeply notched. Thorax more than one-half wider than long, sides very feebly

arcuate, anterior angles short, obtuse, limited within by a deep impression and behind by a finely impressed line, hind angles moderately retracted, somewhat triangular, smooth, separated from the disc by a moderately deep impression, disc slightly convex, sparsely irregularly punctured with smooth spaces and a broad impression at the middle of the sides. Elytra flattened on the disc, surface very coarsely, deeply and densely punctured. Pygidium shining, coarsely and closely punctured. Body beneath coarsely but not densely punctured, abdomen nearly smooth at middle. Legs very closely resembling *nitens*. Length .40 inch; 10 mm. Pl. iv, fig. 9.

This species is easily known from the others of this group by its comparatively shining surface and the sculpture of the thorax. The impression of the disc near the sides is variable in extent, being in some specimens quite feeble.

Occurs in Canada, Middle States and Illinois.

Notes on the Species described or quoted by Prof. Westwood in his "Thesaurus Entomologicus Oxoniensis."

The work of Prof. Westwood, so repeatedly quoted in the preceding pages, seems to require a little more notice than has been given it, from the fact that its distribution in European Libraries will have considerable weight in the determination of our species; and as the species are (with one exception) peculiar to our fauna, it seems proper that they should be reviewed in the light of more material than Prof. Westwood possessed.

In this work there are described as new, seven species, *Lecontei*, *Walshii*, *cicatricosus*, *junior*, *Percheroni*, *crenicollis* and *crassipes*, the type of the latter being in the cabinet of Maj. Parry in London, *Percheroni* in the Univ. Halle, and the others in the Berlin Museum.

With the first six we have more especial need to deal. *Lecontei* and *Walshii* are described from specimens in the Berlin Museum, from very short notes made in 1869, before my synoptic table appeared giving succinctly the differential characters of the species. The next four species "are introduced in this work mainly on the authority of Dr. Schaum, who possessed specimens of them, and who was in an excellent position to judge of their specific rank, both from possessing the typical specimens of Gory, and from his actual acquaintance with the American collections made during a long visit to the United States." The authority from Prof. W.'s own statement is derived from letters written in 1847, '48 and '49! and had the science in America been dormant, those species might possibly have remained twenty-five years undescribed. That they are all to be added to our synonomy is to be regretted, while it is fortunate that so able a describer has made the task of their determination so easy.

As Prof. Westwood has given descriptions of all our species either by quotation or from nature, with figures of many, I propose to pass them briefly in review, giving the synonomy and notes on the figures.

C. (Psilocnemis) *leucostictus* Burm. Westw. Thesaurus p. 56, pl. ii, fig.

4. The thorax of the figure is incorrect in outline and sculpture, and the tarsi too long, except in fig. 4 d. (See annexed plate, fig. 4.)

C. canaliculatus Kby. Westw. p. 58; no figure given.

C. castaneæ Knoch. Westw. p. 59, pl, xiv, fig. 4; a fair figure.

C. Harrisii, Kby. Westw. p. 59; no figure given.

C. Lecontei Westw. p. 60 note, is our western form of *castaneæ*. No figure is given.

C. Walshii Westw. p. 60 note, is the same as *retractus* Lec. I can hardly determine the priority. The latter name appeared in March, 1874, the "Thesaurus" is simply dated 1874. No figure given.

C. variolosus Kby. Westw. p. 60, pl. xiv, fig. 7. The figure is good, except that the sides of the thorax in front of the posterior emargination are much too acutely prolonged.

C. cicatricosus Westw. p. 60, pl. xiv, fig. 9, is *variolosus*, and the figure much better than that above.

C. squamulosus Lec. Westw. p. 60, pl. xiv, fig 8. From the index to plates this figure belongs to the next.

C. junior Westw. p. 61, pl. xiv, fig. 8, is *squamulosus*, and the figure a moderately good one of that species.

C. Percheronii Westw.p. 61, pl. ii. fig. 5, is *variolosus*, and the figure a far better one than those above quoted (pl xiv, figs. 7 and 9).

C. planatus Lec. Westw. p. 62, pl. xiv, fig. 5. The figure is not at all good, the anterior angles of the thorax are represented as double, and the tarsal dilatation not well shown.

C. depressus Horn. Westw. p. 62. A quotation.

C. angularis Lec. Westw. p. 63, pl. xiv, fig. 1. This figure seems to be made from specimens collected by J. K. Lord, in Vancouver, which are the types of Mr. Walker's *C. armatus*. If the tarsi are correctly figured, then this name should have priority over *pilosicollis* Horn, which this figure fairly represents. The tarsi are not those of *angularis* Lec. Westwood says that this species (*armatus*) has been received from Japan.

C. pilosicollis Horn. Westw. p. 63, a quotation. See note above.

C. nitens Lec. Westw. p. 63, pl. xiv, fig. 2. Westwood appears to quote the description, yet gives a figure without stating its source; it is, however, not good.

C. saucius Lec. Westw. p. 64, a quotation.

C. Knochii Lec. Westw. p. 64, pl. xiv, fig. 6; a fair figure.

C. Schaumii Lec. Westw. p. 64, pl. xiv, fig. 3. The figure is a copy from one drawn by Wagenschieber and sent by Schaum, in which the tarsi and tibiæ are not well drawn. The body fairly represents the above species, while, as it stands, it more nearly resembles *Westwoodi* Horn.

C. crassipes Westw. p. 204; Trans. Ent. Soc. London, 1878, pl. 1, fig. 6. This is the true *Schaumii*. I have seen the type. The figure is not a very good one.

C. crenicollis Westw. p. 65, pl. ii, fig. 6, is *Knochii* Lec., and, in 1849, was an undescribed species. The figure is from Schaum by the artist above named, and is a better representation of *Knochii* than that on pl. xiv, fig. 6.

Bibliography and Synonymy.

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C. Wheeleri Lec. Wheeler's Report, 1876, p. 516 (App. H, 10).
C. leucostictus Burm. Handb. III, p. 677.
polita Schaum. Ann. Ent. Soc. Fr. 1844, p. 397.
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crassipes Westw. Thesaurus, p. 204; Trans. Ent. Soc. London, 1878, p. 30, pl. i, fig. 6.
C. Westwoodi, n. sp.
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? armatus Walker, Naturalist in Vancouver, II, p. 320.
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C. Knochii Lec. Proc. Acad. 1853, p. 231.
crenicollis Westw. Thesaurus, p. 65, pl. ii, fig. 6.
C. nitens Lec. Proc. Acad. 1853, p. 232.
C. variolosus Kby. Zool. Journ. II, p. 516; III, p. 152, pl. v, fig. 4-6.
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Sayi Harris. Jour. Acad. V, p. 388.
Percheroni Westw. Thesaurus, p. 61, pl. ii, fig. 5.
cicatricosus Westw. loc. cit. p. 60, pl. xiv, fig. 7.
C. squamulosus Lec. Journ. Acad. 1858, IV, p. 17.
junior Westw. Thesaurus, p. 61, pl. xiv, fig. 8.
C. canaliculatus Kirby. Zool. Journ. III, p. 151, pl. iii, fig. 5, c, d.
castaneæ ‡ Schaum. Germ. Zeits. III, p. 255; Burm. Handb. III, p. 681.
Hentzii Harris. Jour. Acad. V, p. 386.
C. retractus Lec. Trans. Am. Ent. Soc. 1874, p. 54.
Walshii Westw. Thesaurus, Entom. Oxon. Oxford, 1874, p. 60, note.
C. castaneæ Kn. Neue Beitr. p. 115, pl. iii, fig. 1.
Lecontei Westw. loc. cit. p. 60, note.
C. Harrisii Kby. Zool. Journ. III, p. 152, pl. v, fig. 3*a*; Schaum, Germ. Zeitschr. III, p. 254; Burm. Handb. III, p. 680.
castaneæ ‡ Kby. Zool. Journ. II, p. 517; Harris, Journ. Acad. V, p. 384.

Synopsis of the EUPHORLÆ *of the United States.*

BY GEORGE H. HORN, M.D.

(*Read before the American Philosophical Society, Dec.* 19, 1879.)

The occurrence of several new species in our fauna affords an opportunity of briefly reviewing our entire series.

The first question presenting itself is the generic name which should be adopted, and this seems to be a difficult matter to determine. The ablest European authorities who have had to deal with the Cetonia group as a

whole do not seem to be in accord as to the limits of genera, so that we have on the one hand a multiplicity and on the other a synonymic union which does not seem tenable. Lacordaire, under the name *Euryomia*, collects the contents of about ten genera, all of which, with one exception, are the creation of Burmeister. This aggregation is again dispersed in the Catalogus (G. and H.) with *Erirhipis* alone suppressed. It seems highly probable that neither of these extremes is correct.

The name *Euryomia*, at present used in our literature, has for its type a Madagascar species, which presents characters entitling it to be separated from the forms which occur in our fauna, whatever may be its relations with the other old world types which Lacordaire has united with it, consequently our species should bear some other name. *Euphoria* is adopted as most convenient, because the name suggests no special character. Lacordaire states that the genus is not capable of being defined, seeing that the species differ more among themselves than they do in the aggregate from the other neighboring genera. It is, he says, "a genus established on geographical distribution alone."

In a limited series, such as our fauna presents, *Stephanucha* might be allowed to remain separated, but this seems hardly necessary until the limits of all the genera are better defined than they are now.

Having given the reasons for adopting the generic name, the following table of species is presented for the consideration of our students:

Clypeus dentate in front. Base of thorax entire.
- Quadridentate [STEPHANUCHA] ..... **areata** Fabr.
- Bidentate ..... **verticalis**, n. sp.

Clypeus entire or feebly emarginate, the angles rounded.
- Mesosternal protuberance round or nearly so ..... 2.
- Mesosternal protuberance transverse ..... 11.

2. Thorax either shining or punctured and pubescent ..... 3.
   Thorax opaque, scarcely punctured, not pubescent ..... 10.
3. Base of thorax at middle not emarginate ..... 4.
   Base of thorax emarginate at middle ..... 5.
4. Thorax arcuate at base, elytra not sulcate ..... **aestuosa**, n. sp.
   Thorax truncate at base ..... **Kernii** Hald.
5. Punctuation of thorax dense, surface pubescent or hairy ..... 6.
   Punctuation sparse, surface glabrous or scarcely pubescent ..... 7.
6. Body beneath and legs very hairy ..... **hirtipes**, n. sp.
   Body beneath and legs normally hairy ..... **sepulcralis** Fabr.
7. Mesosternal protuberance punctured and hairy beneath .. **devulsa**, n. sp.
   Mesosternal protuberance glabrous beneath ..... 8.
8. Punctuation of thorax coarse, elytra with short and inconspicuous pubescence ..... **melancholica** G. & P.
   Punctuation of thorax sparse, usually inconspicuous, body above entirely devoid of pubescence ..... 9.
9. Elytra reddish-yellow with black fasciæ ..... **fascifera** Lec.
   Elytra variable, the surface with green or blue lustre ..... **fulgida** Fabr.

10. Clypeus longer than wide, rather deeply emarginate. . **californica** Lec
    Clypeus not longer than wide, feebly or not emarginate. . **herbacea** Oliv.
11. Elytra luteous, maculate with small black spots. . . . . **inda** Linn.
    Elytra sooty, with small transverse luteous spots. . . . . **Schottii** Lec.

From the above table I have rejected *basalis*, *dimidiata* and *canescens*, as they are Mexican, and are very rarely found in Texas or Arizona. The species described by Say as *Cetonia vestita* is believed to be *C. hirtella* Linn. (Schaum, Am. Ent. Soc. Fr., 1849, p. 267), and nothing has ever been found since in our country which will fill the description, it is therefore dropped into European synonymy.

E. areata Fab.

Black, moderately shining, elytra luteous with black spaces at the humeri, and subapical umbone and along the suture, upper surface with short erect yellowish pubescence, longer on the head, denser on the thorax and very sparse on the elytra, beneath hairs long and sparse. Clypeus short, narrowed in front, quadridentate, the middle teeth closer and arising from a common base. Thorax oval, base arcuate entire, surface densely punctured. Elytra very obsoletely bicostate, the punctuation very indistinct. Mesosternum feebly prominent, the protuberance transverse. Pygidium usually moderately, densely punctured. Abdomen with very few punctures. Length .48 inch ; 12 mm.

The club of the male antennæ is a little longer than that of the female. The anterior tibiæ are tridentate in both sexes.

The normal form of coloration, and which is almost invariable in the eastern specimens, is that in which the elytra are in great part luteous, with the base narrowly black, the suture is also black, this color dilating into a large circum-scutellar patch, a smaller transverse space behind the middle, and again dilating at apex. In the specimens from Kansas and Nebraska, the elytra are more roughly sculptured and almost entirely black, the luteous color being reduced to a U-shaped mark by the extension of the elytral black spaces, and by the margin being dark.

A specimen in Mr. Ulke's cabinet requires special mention. It is of the size of *aestuosa*, the humeri and subapical umbone are similarly tipped with piceous, and the suture very narrowly piceous, disconnected from the suture and along the region occupied by the faint costæ are irregular small piceous patches. The sides of the thorax are irregularly bordered with a whitish coating, and the pygidium

except at tip clothed with similar material. The clypeus is formed as in normal *areata*, and the characters generally are those of that species. From its appearance it might be suspected of being a hybrid between *aestuosa* and *areata*.

Occurs from the Middle States, westward to Kansas, and south to Texas.

E. verticalis, n. sp.

Black, moderately shining, upper surface without pubescence, form robust, moderately convex. Clypeus as long as wide, a little narrowed in front, anteriorly emarginate, the angles acute and reflexed, vertex with an obtuse tubercle, surface of head coarsely, densely and deeply punctured. Thorax oval, narrowed in front, broader than long, sides strongly arcuate, especially in front, base less arcuate, not emarginate, disc moderately convex with coarse punctures sparsely placed, but closer near the anterior margin, a narrow smooth median space. Scutellum smooth. Elytra one-half longer than the thorax, disc with rows of ocellate foveæ forming nearest the suture two distinct pairs separated by very feeble costæ, between the ocellate foveæ are simple punctures distantly placed, at the sides the punctures are irregular, and more densely placed; sutural angle obtuse. Pygidium sparsely punctate. Body beneath with brownish hair, abdomen nearly smooth, a few coarse punctures at the sides only. Length .52 inch; 13 mm. Pl. iv, fig. 12.

The sexes differ only in the form of the pygidium, that of the male being more convex and inflexed at tip. The anterior tibiæ are acutely tridentate, the upper tooth more distant than the other two. The antennal club is nearly as long as the entire stem in both sexes. The mesosternal button is transversely oval and hairy in front.

In general form this species resembles *areata*, but is a little more robust. It is easily known among the species in our fauna by its bidentate clypeus and totally black color, as well as by the elytral sculpture. By its form of clypeus it is allied to *E. Hera* Burm. from South America.

Two specimens are before me, one of each sex from Arizona, and the adjacent portion of California.

E. aestuosa, n. sp.

Piceous, moderately shining, body above luteous, thorax with a large median piceous space, humeral and subapical umbones of elytra tipped with piceous, form moderately robust, surface above and beneath with short, inconspicuous pubescence. Clypeus a little wider than long, slightly broader in front, angles rounded, anterior margin moderately reflexed and

slightly emarginate at middle. Head and front coarsely and densely punctured with moderately long hair. Thorax oval, narrowed in front, slightly wider than long, sides moderately arcuate, base not narrower than middle, basal margin regularly arcuate, surface coarsely and densely punctured, with short erect yellowish pubescence. Scutellum smooth. Elytra moderately convex, disc very vaguely bicostate, surface irregularly sparsely punctate. Body beneath piceous, shining, sparsely hairy, tibiæ very feebly fimbriate. Pygidium concentrically strigose, smooth near the tip. Mesosternal button round, hairy. Length .54 inch; 13.5 mm. Pl. iv, fig. 14.

In the unique ♀ before me, the club of the antenna nearly equals the stem. The anterior tibiæ are acutely tridentate, the teeth rather long and equidistant. From the few species in our fauna which have the base of the thorax simply arcuate, this species differs, either by the form of the clypeus or the elytral and thoracic sculpture.

One specimen, Kansas, given me by Dr. S. V. Summers. It is probable that the color will vary from this unique. The scutellum is black, and the suture and apical margin narrowly piceous, and these spaces may possibly be found extending so as to form a style of coloration analogous to that of *areata*.

E. hirtipes, n. sp.

Piceous, elytra luteous, above with moderately long yellowish hair. Clypeus as broad as long, not narrowed in front, anterior angles broadly rounded, apical margin slightly reflexed, feebly emarginate. Head coarsely and densely punctured, clothed with rather long yellowish hair. Thorax oval, broader than long, narrower in front, sides strongly arcuate, base narrower than middle, the margin broadly arcuate, and opposite the scutellum emarginate, disc moderately convex, surface densely but rather irregularly punctured, a smooth space along the middle and one on each side, pubescence rather long and erect. Scutellum smooth, a median impression near the tip. Elytra slightly narrowed toward the tip, disc feebly convex, vaguely bicostate, the intervals irregularly punctured, the punctures bearing moderately long hairs. Pygidium moderately densely punctured and hairy. Body beneath and legs clothed with long yellowish hair. Abdomen coarsely punctured. Mesosternal button round and hairy in front. Length .42♂–.56♀ inch; 10.5–14 mm. Pl. iv, fig. 13.

The antennal club is about the length of the stem, and similar in the two sexes. The anterior tibiæ are rather broad, tridentate, the apical tooth longer and more distant than the other two. The legs are less hairy in the female

than in the male, which has, especially on the hind tibiæ, a dense brush of long hair on the inner side.

In form, this species bears a resemblance to *sepulcralis*, but so differs in color and vestiture, not only from this, but also from all our others, as to make it very conspicuously distinct.

Occurs in Dodge county, Nebraska.

E. Kernii Hald.

This species has become so generally known as to need no extended description. The clypeus is nearly square, the angles rounded, the anterior margin feebly emarginate. The thorax is transversely oval, base truncate at middle, surface densely and coarsely punctured. The elytra are each rather broadly and deeply bisulcate, the surface sparsely punctate and at the sides transversely wrinkled. The pygidium is concentrically strigose. The mesosternum does not project in a button-like protuberance. Length .40–.52 inch; 10–13 mm.

The male antennal club is a little longer than that of the female. The anterior tibiæ are very decidedly tridentate in the female and either simply bidentate in the male or with the upper tooth showing a very feeble trace.

No species in our fauna exhibits such a wide range of color variation.

In the normal form the under surface and legs are piceous or black. Head black. Thorax black, sides more widely, base very narrowly bordered with yellow. Elytra in great part yellow or reddish-yellow, maculate with black spots of irregular size and shape, becoming more or less confluent.

The first noticeable variety (*Clarkii* Lec.) has the abdomen, posterior legs and the anterior four tibiæ pale reddish-yellow. The discal black space of the thorax is divided by a pale median stripe, the elytra remaining normal in color.

Fully as common as this last variety is one in which the entire body above and beneath is black.

These last forms resemble the species described further on as *devulsa*, but this has the base of thorax emarginate.

Occurs over the region of the Plains from Kansas to Texas.

E. devulsa, n. sp.

Piceous black, shining, sparsely clothed with very short inconspicuous

pubescence. Clypeus a little wider than long, sides feebly arcuate, anterior angles broadly rounded, apical margin slightly reflexed and feebly emarginate at middle. Head coarsely and densely punctured, more sparsely on the clypeus. Thorax oval, narrowed in front, broader than long, sides regularly arcuate, basal margin emarginate at middle, disc moderately convex, coarsely but not densely punctured. Scutellum coarsely punctured at the sides. Elytra moderately convex, sub-bicostate on the disc, the intervals with variolate fovea, which gradually become simple punctures toward the sides of the elytra, sutural angle rectangular. Body beneath sparsely clothed at the sides with yellowish hair, abdomen very sparsely punctate and with few hairs at the sides. Tibiæ slightly fimbriate within. Pygidium concentrically strigose. Mesosternal button punctured and hairy beneath and in front. Length .40♂–.48♀ inch; 10–12 mm. Pl. iv, fig. 15.

The anterior tibiæ are tridentate in the two sexes, the upper tooth more distant. The antennal club is very nearly as long as the rest of the antennæ.

This species resembles the Mexican *E. dimidiata* in form, sculpture and size, and differs in the style of coloration and the punctured scutellum. It also resembles the entirely black varieties of *Kernii*, but the latter has more deeply sulcate elytra and the thorax truncate at base.

The males differ from the females by their smaller size, narrower form and more convex pygidium.

Occurs near San Antonio, Texas.

E. sepulcralis Fab.

Body beneath bronzed, shining, distinctly violaceous, above dark bronze, not very shining. Clypeus a little wider than long, anterior angles rounded, apical margin slightly reflexed, not emarginate, surface coarsely punctured, vertex with short erect yellow hairs. Thorax transversely oval, sides arcuate, base emarginate at middle, surface coarsely punctured, not densely at middle, but densely and subconfluently at the sides, pubescence short, erect and very persistent. Scutellum usually smooth, often sparsely punctured at the sides. Elytra distinctly bicostate, intervals with numerous punctures which tend to become ocellate foveæ, at sides the punctures are converted into short, deep transverse strigæ, especially near the apex, surface sparsely pubescent with numerous short, sinuous lines of whitish or ochreous color; tip of elytra distinctly sinuous, the suture slightly prolonged. Pygidium concentrically strigose, often whitish at the sides. Mesosternal umbone transversely oval. Metasternum smooth at middle, strigose, and often coated with white at the sides. Abdomen sparsely punctured at middle, at sides more coarsely and with few hairs, often with whitish coat. Length .44–.60 inch; 11–15 mm.

The club of the male antenna is very little longer than that of the female, the anterior tibiæ tridentate in both sexes.

This species is, next to *inda*, the most common in our fauna. It occurs from the Middle States westward to Kansas, and to Florida and Texas, extending even into Mexico.

The above description, rather detailed for one so common, is given that the specific limits when compared with *melancholica* may be made more evident.

E. melancholica Gory.

Body beneath black, shining, usually with green or dark blue lustre, upper surface equally shining, surface greenish-blue or nearly black. Clypeus as in *sepulcralis*, head not hairy. Thorax formed as in that species, the punctuation coarse, denser at the sides but not confluent, the surface entirely devoid of hairs. Elytra also similar, the punctuation less deep and more sparse, and at the sides very faintly or not at all strigose, surface devoid of hairs, and with whitish lines similar to those of *sepulcralis* but less sinuous. Body beneath as in *sepulcralis*. Length .48–.60 inch; 12–15 mm.

The antennal club of the male is very distinctly longer than that of the female. The anterior tibiæ are tridentate in both sexes, but the upper tooth is smaller in the male.

By a comparison of descriptions it will be seen that this species is more shining, less deeply sculptured, and the upper surface without pubescence. The sculpture of the thorax and sides of elytra is notably different in the two. Here the sides of the thorax are usually margined with cretaceous, but in *sepulcralis* rarely so. The sexual characters here are also better marked.

Occurs in Kansas, Texas and Mexico.

E. fascifera Lec.

Black, shining, glabrous. Clypeus as broad as long, anterior angles rounded, margin reflexed, not emarginate, surface coarsely and densely punctured. Thorax triangular, sides feebly arcuate, base emarginate in front of scutellum, apex truncate, the middle of apical margin slightly elevated in a tubercle, surface sparsely punctate, color reddish-yellow, with a large triangular black space, or with the space replaced by four black spots. Elytra vaguely bicostate, punctures sparse and coarse, on the disc sub-ocellate, color a reddish-yellow, with a basal, median and sub-apical transverse dentate fascial black. Pygidium concentrically strigose. Body

beneath very coarsely transversely strigose, and with sparse short pubescence. Abdomen very sparsely punctate, and slightly pubescent at the sides. Mesosternal umbone moderately prominent, rounded at tip. Length .52–.74 inch; 13–19 mm. Pl. iv, fig. 16.

The club of the male antenna is a little longer than that of the female; anterior tibiæ tridentate in both sexes.

The specimens before me, six in number, are exactly alike in their elytral markings, scarcely varying in the minutest detail; in one in my cabinet, from Utah, the thorax has the large black discal space replaced by four smaller spots.

The entirely glabrous surface and the general outline of this species place it in close alliance with *fulgida*.

Occurs in the Peninsula of California, and extends to South-western Utah at St. George (Dr. Palmer).

E. fulgida Fab.

This species, well known from its brilliant green surface, varying to blue, needs but little comment. The upper surface is entirely devoid of pubescence. The head is brilliant green, the thorax similar in color, but margined at the sides with yellow, its surface sparsely punctate. On the elytra the traces of costæ are almost entirely obliterated, the punctuation usually sparse and indistinct, often more or less maculate, with cretaceous spots. The pygidium is concentrically strigose, and with four cretaceous spots more or less confluent. The metasternum is smooth at middle, and at sides deeply strigose. The abdomen is smooth, with but few coarse punctures at the sides, and along the margin of the segments, the sides are usually broadly cretaceous, sometimes with a double row of cretaceous spots. The mesosternal umbone is prominent, oval at tip. The legs are reddish or brownish-yellow, tarsi piceous. Length .52–.80 inch; 13–20 mm.

The male has a larger antennal club than the female, the tibiæ are tridentate in both.

In the specimens from the Northern States, the elytra have less of the greenish surface lustre, and exhibit a brownish-red ground color; these have also the fewest whitish spots. In the specimens from the Gulf States, the color is always more brilliant, the punctuation more evident, and the whitish spots more numerous.

Occurs from the Middle States westward to Missouri, and south to Florida and Texas.

E. californica Lec.

Bright green, opaque above, shining beneath, very similar to *fulgida*, upper surface without pubescence. Clypeus longer than wide, slightly

narrower in front, apical margin deeply emarginate, feebly reflexed, surface not densely punctured. Thorax transversely oval, sides rather strongly arcuate, base emarginate at middle, disc moderately convex, sparsely obsoletely punctured, a small white spot on each side of middle, lateral margin very narrowly cretaceous. Elytra obsoletely bicostate, the punctures between the costæ very fine and in two rows, sides rather strongly plicate, suture rather strongly elevated, especially near the tip, where it is slightly prolonged, surface opaque green with small cretaceous spots, the first at middle on the inner costa, the second at three fourths, between this costa and the suture, a third behind the second near the apex, two at the margin placed obliquely behind the first two, a very small spot behind the humerus. Pygidium strigose, a white spot each side. Body beneath shining green, sparsely clothed with hair along the sides. Metasternum and abdomen smooth at middle, coarsely punctured at the sides. Meso-metasternal protuberance long, parallel, rounded at tip. Legs bright green, tarsi black. Length .64 inch; 16 mm.

Of this species I have seen but one specimen, the type. It was given by Baron Osten-Sacken to Dr. Leconte, with the statement that he obtained it in California, but I do not know if it was collected by him. The species seems to me to resemble the East Indian type and to belong to the genus (?) *Glyciphana*, but until an opportunity is afforded for comparison no positive statement can be made, and I leave it with the doubts above given.

E. herbacea Oliv.

Body beneath green, moderately shining, above dull green, changing to opaque brown. Clypeus as broad as long, sides and apex reflexed, the latter not emarginate, surface sparsely punctate. Thorax transversely oval, sides moderately arcuate ♀, or more triangular with sides nearly straight ♂, base emarginate at middle, disc sparsely punctate. Elytra vaguely bicostate, intervals finely punctate, sides with coarse strigæ, surface variable from brownish-green to brown, opaque, with numerous whitish spots of irregular size and shape behind the middle and near the apex and sides. Pygidium concentrically strigose and with short hairs. Body beneath green, shining, abdomen often brownish. Metasternum smooth at middle, strigose and hairy at the sides, abdomen sparsely punctate over the entire surface, pubescent at the sides. Mesosternal button oval, a little broader than long. Length .56–.64 inch; 14–16 mm.

The male club is very decidedly longer than that of the female, the anterior tibiæ tridentate in both sexes.

This species is entirely devoid of pubescence on the upper surface, except the head and pygidium. It is a well-known species to all collectors, but less common than *inda*.

Occurs in the Middle States region, occasionally found abundantly, but usually not common.

E. inda Linn.

Clypeus broader than long, apex not emarginate, angles rounded, margin reflexed. Mesosternal button more than twice as wide as long.

This species is so well known as to require no further comment.

Occurs everywhere in the United States east of the Rocky Mountains.

E. Schottii Lec.

Black, beneath shining, above opaque, elytra variegated with short transverse luteous spots. Clypeus nearly square, anterior angles rounded, apical margin slightly reflexed, truncate, surface coarsely and moderately densely punctured sparsely clothed with erect yellowish hair. Thorax subtriangular, sides feebly arcuate, base emarginate at middle, surface coarsely punctured, more densely at the sides and very sparsely near the base, pubescence short and sparse, color piceous with three luteous vittæ at middle. Elytra piceous opaque, with irregular, short, transverse and sinuous luteous spots, disc vaguely bicostate, intervals biseriately vaguely punctate, at sides irregularly punctate and posteriorly distinctly plicate. Pygidium indistinctly concentrically strigose. Mesosternal protuberance transverse, arcuate in front. Metasternum smooth at middle, coarsely strigose at the sides, sparsely pubescent. Abdomen very sparsely punctate and with short pubescence. Femora brownish, tibiæ and tarsi piceous. Length .44–.56 inch; 11–14 mm.

The club of the male antenna is very nearly double that of the female, the anterior tibiæ are bidentate ♂, or tridentate ♀.

In form this species bears a considerable resemblance to *herbacea*, being much less robust and more depressed than *inda* and with less distinct pubescence. There is, however, a very close relationship between *inda* and *Schottii*, as shown by a general similarity of appearance, and the form of the mesosternal protuberance.

Occurs in Texas, Eagle Pass.

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marylandica Fröhl. Naturf. 26, p. 116.
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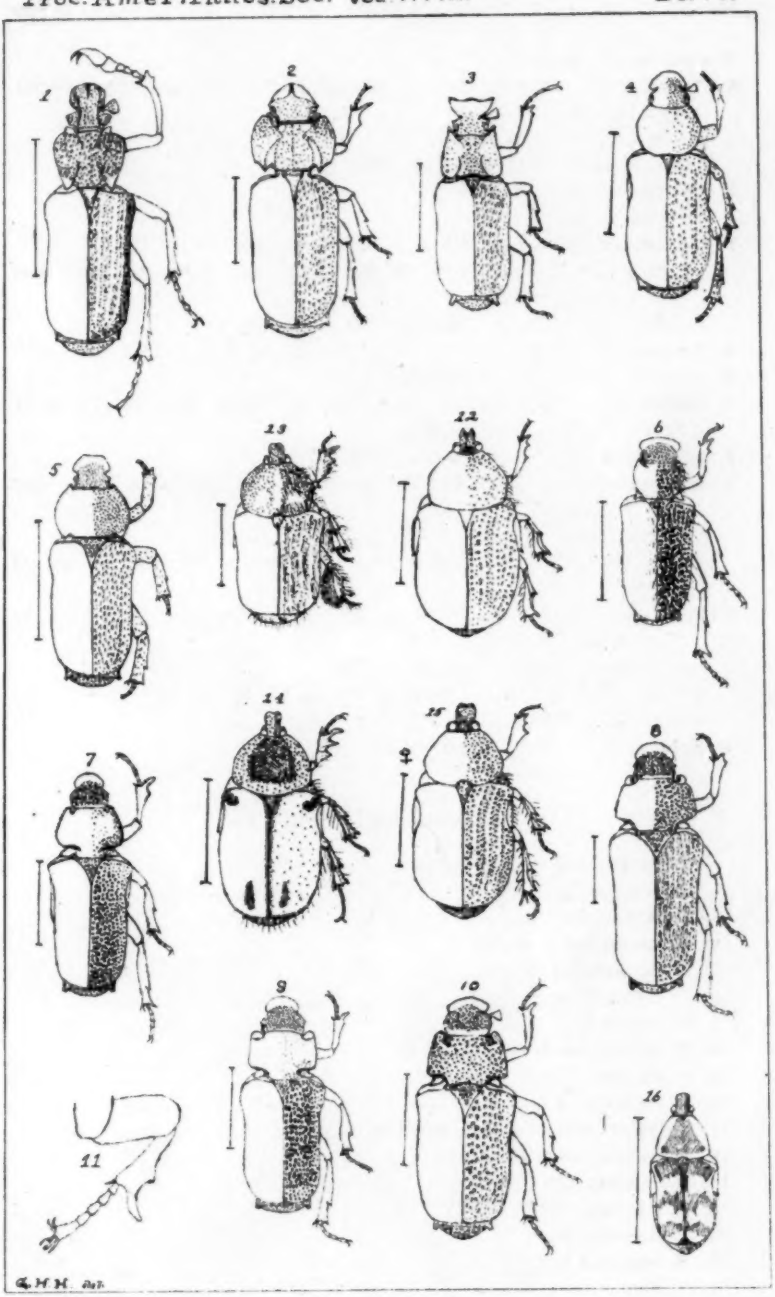
Explanation of Plate IV.

1. **Cremastochilus planatus** Lec.
2. **C. saucius** Lec.
3. **C. Wheeleri** Lec.
4. **C. leucostictus** Burm.
5. **C. Schaumii** Lec.
6. **C. crinitus** Lec.
7. **C. nitens** Lec.
8. **C. variolosus** Kby.
9. **C. Harrisii** Kby.
10. **C. retractus** Lec.
11. Tarsal monstrosity in **C. saucius**.
12. **Euphoria verticalis** Horn.
13. **E. hirtipes** Horn.
14. **E. aestuosa** Horn.
15. **E. devulsa** Horn.
16. **E. fascifera** Lec.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[*Erratum for No.* 103, *page* 258.]

In third line from bottom, for 1000 *metres* read 1000 *feet.*

NOTE.—Plate IV, should be Plate V.